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Oceanographic investigation of the marginal sea ice zone of the Chukchi Sea -- MIZPAC 1974

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OCEANOGRAPHIC INVESTIGATION OF THE MARGINAL
SEA ICE ZONE OF THE CHUKCHI SEA--
MIZPAC 1974

by

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

Continuous profiles of temperature and salinity (STD observations) were made in the shallow (∿45 m) Bering and Chukchi Seas in July 1974 as part of the MIZPAC program. In addition to measurements in ice-free waters, seven closely spaced crossings of the sea-ice margin were made along with two crossings of the Alaskan coastal zone. In all, 111 STD stations and approximately 100 XBT drops were made for which graphs and tabulations were produced of temperature, salinity, density and sound speed.

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20. (cont'd.)

South of the ice the water is sharply layered with a warm fresh layer (8-10^{o} C and ∿10m thick) above a cold dense layer. At or near the sea-ice margin the layering gradually disappears with modification of isopycnals and isotherms extending to the bottom. Large scale temperature fluctuations of 0.5 to 2^{o} C, termed mesostructure, were observed at 12-15m depth in the first three crossings, but were weak or absent in the other crossings. Mesostructure appears to be correlated with a relatively rapid melting of the ice, and hence, probably with a strong northward flow, or a diffuse ice margin. Mesostructure formation is believed to result from non-uniform lateral mixing of waters of different temperatures but the same density, possibly modified or controlled by a complex lateral pressure field near the ice.

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I. INTRODUCTION

This report describes the results of a cruise, termed MIZPAC 74, conducted in the northern Bering Sea and in the sea-ice margin of the Chukchi Sea to examine the processes which lead to mesoscale temperature structure in the water column. The field work was carried out from the icebreaker USCGC BURTON ISLAND during the period 13-30 July 1974 using a continuously profiling instrument.

These oceanographic investigations of the marginal sea-ice zone are part of a long-term program, Project MIZPAC, which is under the direction of the Arctic Submarine Laboratory, Naval Undersea Center, San Diego. Applied objectives of MIZPAC include development of arctic submarine technology and enhanced understanding of the complex acoustic environment of the MIZ. Personnel from the Applied Physics Laboratory, University of Washington (APL) also participated in MIZPAC 74 taking acoustic and biological and physical measurements. Their temperature and salinity data were taken concurrent with our observations using a different instrument, the conductivity-temperature-depth recorder (CTD) built by APL.

This cruise was the third in a series of cruises conducted in the Pacific marginal sea-ice zone (MIZ) in which personnel from the Naval Postgraduate School have participated. Previous cruises in July and August of 1971 and 1972 in the Chukchi and Beaufort Seas have established the presence of a thermal mesostructure near the ice edge which appears to be highly variable over short time and space scales (Paquette and Bourke, 1973). The primary purpose of this cruise was to obtain many closely spaced samples of the thermal structure over a large area of the MIZ to further establish the character of the

mesostructure, its distribution and strength relative to its distance from the ice edge, and the probable oceanographic mechanisms which cause it to form.

II. GENERAL PROCEDURE

A. TECHNIQUES

As in the previous two cruises in 1971 and 1972, the primary instrument was the Bissett-Berman Model 9006 STD kindly loaned by the Arctic Submarine Laboratory. This is an "Arctic" model because of the extended temperature scale to -2°C. However, the instrument has to be modified with the application of a 400 ohm resistive shunt to read salinities lower than 30 $^{o}/_{oo}$, its nominal lower limit. Two lowerings of the STD were therefore required for stations located in the immediate vicinity of the ice; the upper portion of the water column was recorded with the shunt, the remainder without the shunt. The effect of the shunt and the errors introduced due to the lag in the compensating thermometer of the salinity sensor are described in the report summarizing the MIZPAC 71 and 72 cruises (Paquette and Bourke, 1973). The manner of correcting these errors is described in Part C of this section.

The STD was standardized at most of the stations by means of a Nansen bottle, just above the instrument, which was tripped at the maximum depth of lowering. The salinity and temperature offsets were found to be reasonably constant over long periods; during these periods constant additive corrections were applied throughout the water column. The standard deviations in the temperature and salinity errors approximated 0.04°C and 0.02 o/oo, respectively.

Bucket samples of salinity and temperature were taken at most of the stations. They could not be used for standardization because of the large gradients between the surface skin and the approximate one meter depth of the STD. The bucket measurements were incorporated in the final digital data at zero depth. Later, it was found that the detail in the upper meter of water had a considerable effect on the dynamic heights. Data from the CTD measurements of APL were used to supply this detail where necessary.

Shallow-water XBT's (Model T-10) were used to supplement the STD measurements. The XBT recorder was modified by replacing the chart-drive motor by a faster motor and using a chart paper calibrated for 200 m maximum depth. This has the effect of expanding the depth axis of the temperature trace. Mesostructure could be observed but the XBT has too rapid a rate of fall or, conversely, too slow a temperature sensor to reproduce the mesostructure faithfully and the features are therefore somewhat smoothed.

The general observational technique was to make closely spaced measurements on a line normal to the ice edge starting 10 n mi outside and penetrating 10 n mi into the ice or to a distance where the structure vanished. Penetrations were usually 30 n mi apart.

B. CRUISE PLAN

Figure 1 is a map showing the positions of the one hundred and eleven stations occupied during MIZPAC 74. Equipment problems with the STD eliminated observations at Stations 1,3,4, 12, 13, and 41, but data from the APL's CTD are available for these stations. Data taken during the early part of the cruise (while transiting to the ice margin) were

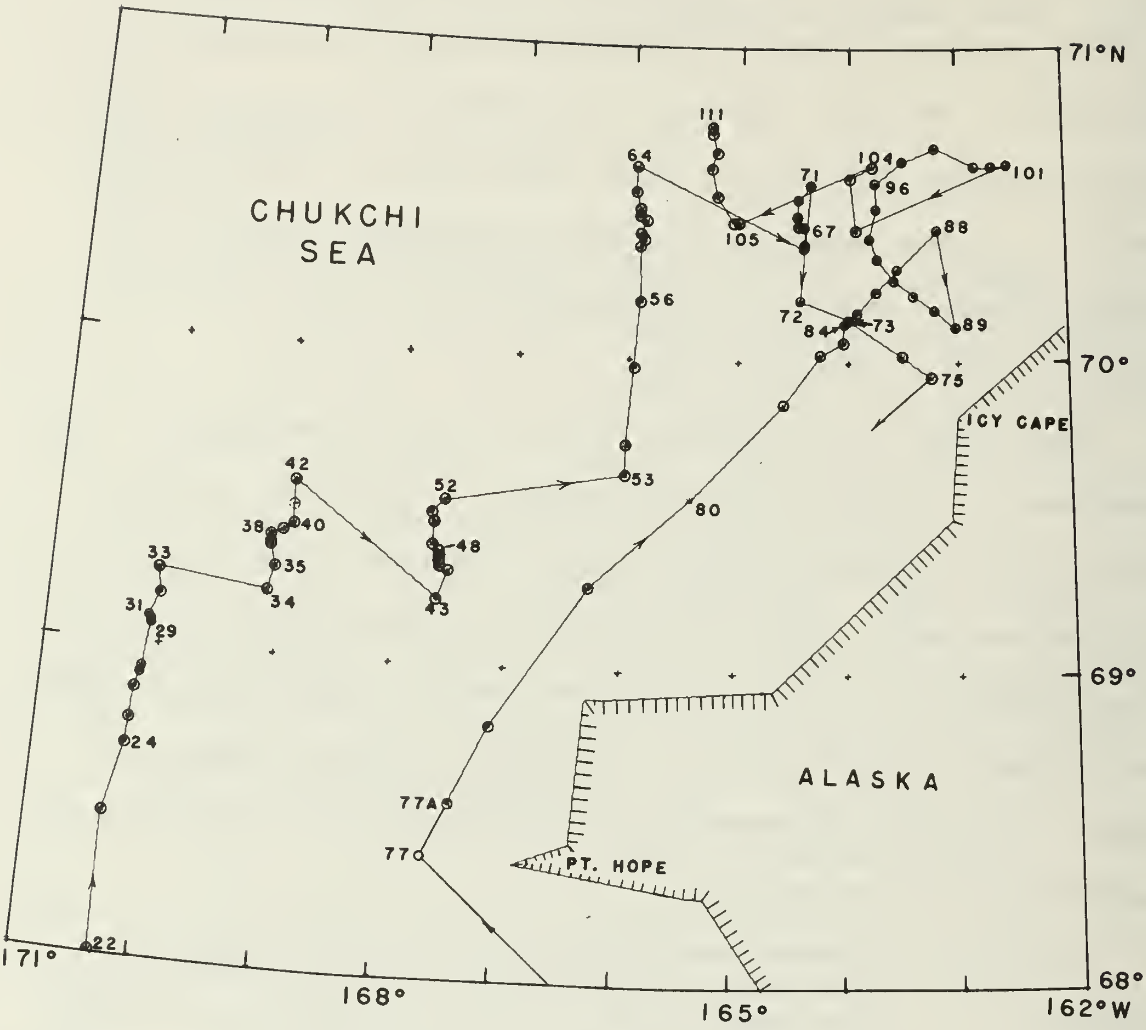


Figure 1. MIZPAC 74 STD station positions.

for the purpose of establishing the characteristics of the water flowing into the Chukchi Sea. A little ice was first encountered at Station 27; a better defined ice margin was at Station 29. The ice margin was initially quite diffuse and some trouble was experienced in locating and defining the ice edge. There was no good distant overview to tell when the ice seen dimly ahead through the fog or on radar was a substantial margin or only a line of large floes. Therefore, the ice margin is sometimes poorly defined, and some crossings contain the complicating influence of isolated patches of diffuse ice well south of a denser margin. On 24 July, midway into the cruise, strong winds from the south developed, causing the ice margin to become compact and characterized thereafter by 8 oktas of ice.

Seven ice-margin crossings were made during the cruise. These were the station sequences 24-33, 34-42, 43-52, 53-64, 65-71, 93-98, and 105-111. For convenience these are called Crossings Nos. 1 to 7, respectively. In addition, two crossings of the warm coastal current and a transect along its axis were made. Nine XBT transects of 7-10 observations each were made, most of them while retreating from points of maximum ice penetration (Figure 2). It was expected that this procedure would give a more nearly synoptic picture of the temperatures in the cross-section and that there might be some advantage in accuracy and uniformity of spacing compared with the time-consuming STD stations during which the ship could drift.

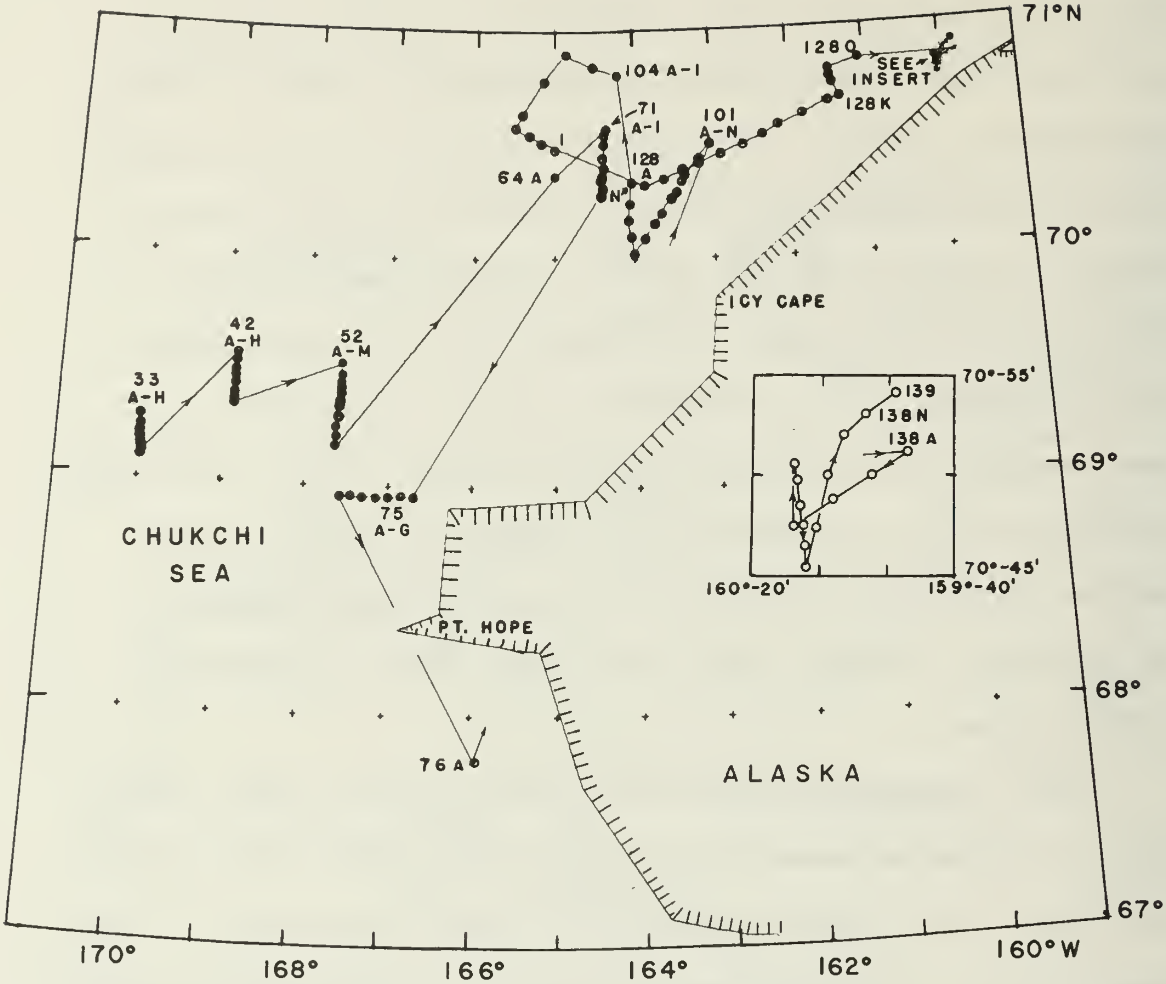


Figure 2. MIZPAC 74 XBT station positions.

C. REDUCTION OF DATA

The same data reduction techniques as employed previously (Paquette and Bourke, 1973) were used on the 1974 data with some minor changes. Basically the procedure was to trace the original STD plots with the Calma digitizer and to use a computer program, MIZ2, which converts the digitizer tapes to corrected temperatures and salinities, computes sound speed and sigma-t, and does a certain amount of editing prior to producing printed and tape outputs. Plots were then made of property profiles of each station.

For the 1974 data we initially attempted to treat the spiking which routinely appears in the temperature and salinity traces in a different fashion than previously. In the past we had faithfully traced the temperature profile, but eliminated any spikes while tracing the salinity curves. This time we first tried including all the temperature and salinity spikes during our tracing operations and attempted to remove the anomalous spiking with a first order response equation. This procedure was only partially successful presumably due to the large proportion of second and higher-order response in the thermal compensator. We then resorted to hand-smoothing the salinity curves prior to tracing, being guided by the regions of the temperature curve where its slope was near zero and the salinity could be presumed to be undistorted. This technique eliminates the possibility of finding salinity inversions and density inversions, but we believe the inversions which might exist are slight.

The plotting routines were modified to simplify data preparation and to obtain a more compact presentation. Property profiles from each STD station were plotted, four per page. These profiles along with the heading data for each station are in Appendixes I and II of this report. Both the shallow and deep lowerings are on the same plot. Occasionally, the overlap between the two lowerings is not perfect, causing a break to appear in the curves. The temperature trace is marked with crosses, and the salinity with dots every 20 depth increments, and we have occasionally introduced a small symbol (T, S, V, Σ) to help distinguish curves. The surface bucket measurements are marked on the abscissa by symbols, as above, but the curves are not drawn to them because of the resulting deterioration in legibility; property gradients in the top meter often are large.

Nested temperature profiles for each XBT line are shown in Appendix III along with the station heading data. The temperature traces are normally spaced 1° C apart with the deepest temperature printed below each trace. Occasionally, to avoid confusion with overlapping traces, the temperature offset was increased by an integral number of degrees. The tick marks on the abscissa are 1°C apart.

Vertical temperature profiles and temperature and sigma-t cross-sections were constructed for each of the seven ice-margin crossings. These are shown in Appendix IV.

III. RESULTS

A. GENERAL OCEANOGRAPHY

The waters south of Bering Strait, as one might expect, were fairly warm at the surface, 6° - 8° C, and sharply stratified, the upper layer extending to a depth of 10 - 20 m. However, the upper

layer had a salinity of about 32 o/oo, a fairly high value in view of the presumed northerly transport of water from the Yukon and Kuskokwim rivers. The lower layer was relatively cold, ranging between about 0^{o} and 3^{o} C, with salinity between 32 and 33 o/oo, only a few tenths of a unit more saline than the upper layer.

In Bering Strait warm surface water is present as a thin layer of about 5 m thickness along the eastern side. Stations 13 and 14 show surface temperatures of $8-10^{o}$ C, while 5 n mi farther westward surface temperatures are about 3^{o} C. Below the warm layer, only at Station 13, and presumably eastward, is the water column fairly warm, remaining above 5.9^{o} C at all depths. In the western portion of Bering Strait, Stations 14-16, temperatures are about $1-2^{o}$C. With the exception of the shallow surface layer, the water column across Bering Strait is nearly isohaline and isopycnal. This is similar to the results shown by the Naval Oceanographic Office (1958) or NORTHWIND 1967 (Husby, 1969).

North of Bering Strait the water became more stratified again, at first only in temperature, at Station 22, but at Station 23 a pronounced decrease in salinity developed in the upper layer and was maintained farther north. The temperature of the upper layer rose toward the north, reaching a maximum of nearly 8^{o} C at Station 23. At the next station, 18 nmi south of the then existing ice margin, the influence of the ice began to be noticeable. Not only was there pronounced surficial cooling, leaving a subsurface temperature maximum, but mesostructure began to develop and assumed various forms as the ship progressed through the ice margin at Station 29 and beyond. These relationships from Station 24 northward may be seen in Figure 7, and

the development of the upper stratum farther south in the temperature-salinity diagram, Figure 3.

The development of a two-layered system between Station 22 and the ice is an interesting phenomenon. The sharply stratified upper layer at Station 23 cannot be presumed to originate in Bering Strait even if the waters there were less saline at an earlier date because the mixing which goes on there makes a thick, low-salinity upper stratum unlikely. The diminished salinity in the upper stratum can only have come from the melting of ice which was present north of Bering Strait. The resulting diluted layer must then have been pushed northward by the northward-flowing waters.

It is easy to demonstrate that the dilution is of the proper magnitude to correspond to the thickness of the ice cover. If one assumes an ice thickness of 140 cm, an ice salinity of 4 o/oo, and an ice density of 0.92, and computes the dilution of 12 m of a water column similar to Station 22 by the ice standing above it, the resulting salinity is 29.9 o/oo, very near the 30.2 o/oo observed for the upper layer of Station 23. Thus, the diminution in salinity is almost exactly as great as would correspond to the melting of a typical ice layer.

The position of this low-salinity layer at a distance of 147 n mi north of Bering Strait thus suggests a mean flow northward in the surface layers of 147 n mi during the forty days between 7 June, the the approximate date at which the ice margin passed Bering Strait, and 17 July. This corresponds to a mean velocity of 3.7 n mi/day or 0.15 knot.

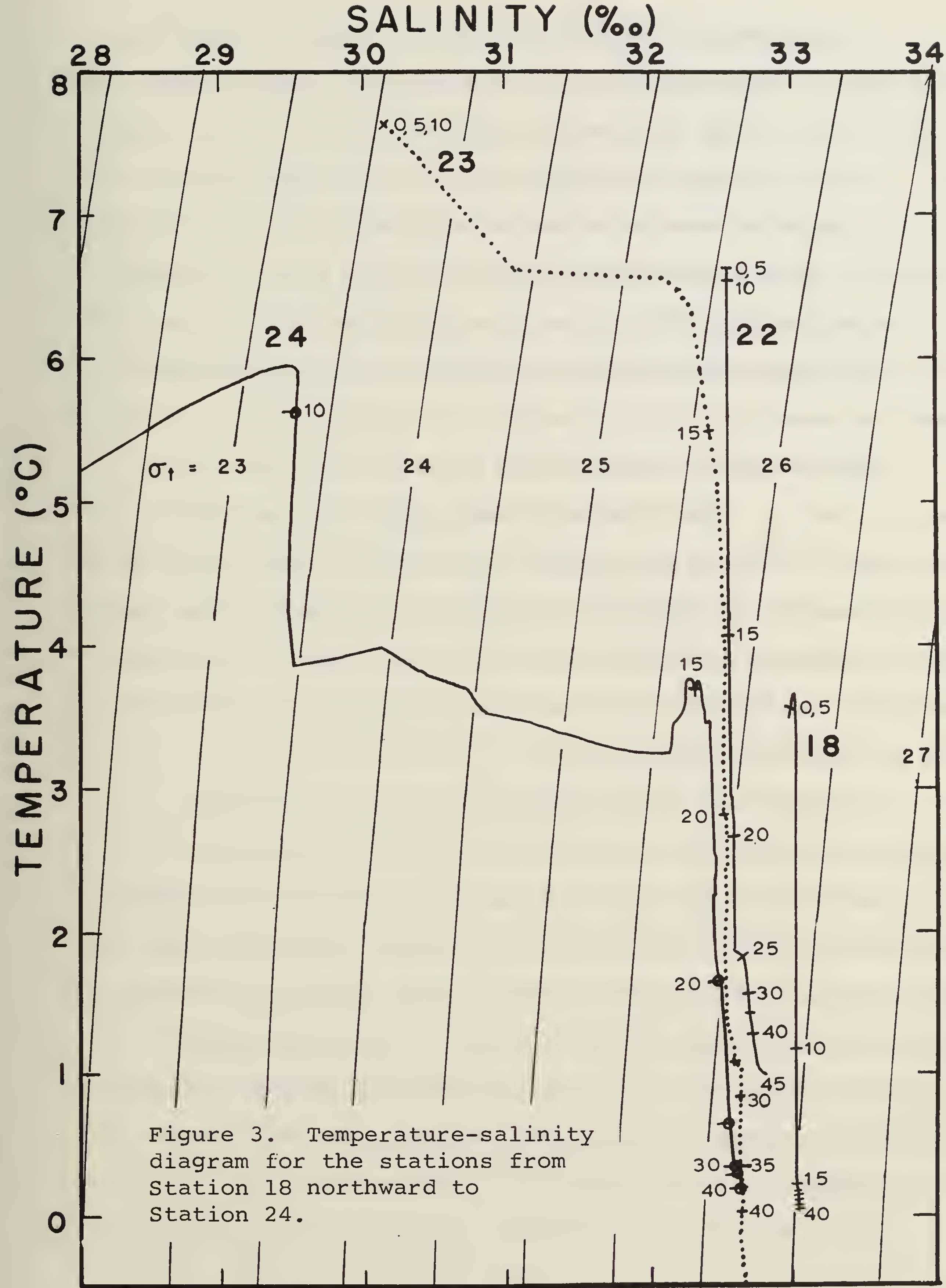


Figure 3. Temperature-salinity diagram for the stations from Station 18 northward to Station 24.

A more meaningful result is in terms of transport. During those forty days the flow would have filled a triangular volume about 200 n mi wide by 147 n mi long by 26 fathoms deep, a total of 377 n mi^3 or 2400 km^3. This corresponds to a transport of 0.7 Sv, assuming that the entire water depth moves at the same speed. This result is somewhat lower than the 1.2 Sv estimated by Mosby (1963) but agrees as well as may be expected considering the crude assumption that the latitude of Station 23 bounds the base of the triangular area and the likelihood that the transports through Bering Strait are highly variable.

The low-salinity layer beginning at Station 23 is only 33 n mi south of the ice. This close relationship prompts the question, "Is the retreat of the ice margin somehow coupled to the flow rate through Bering Strait?". Certainly, the water cannot be advancing faster than the ice margin is retreating or the warm surface layer would be pushed under the ice. Perhaps the ice margin is retreating only as fast as the northward-flowing water melts it.

The latter idea may be explored by computing the flow rate necessary to melt 140 cm of sea ice with a layer of water at 7.6° C, 12 m deep, as at Station 23. We assume that this water moves forward uniformly as a layer, with no backward diffusion. Such motion does not really occur and the waters to the south of the ice are cooled by the diffusion of cold melt water southward. Thus, for our simple concept of motion, it is necessary to pick the temperature of a source water from a station far enough south to escape most of the effects of diffusion.

The heat of fusion of sea ice depends upon the the assumed temperature of the ice and its salinity when melting begins. The conditions assumed are ice temperature and salinity, -2° C and 4 o/oo; terminal water salinity, 30 o/oo, whence the heat of fusion is 70.8 cal/gm. The resulting requirement for water flow to melt the ice is 0.82 times the rate of retreat of the ice. Therefore, there is sufficient heat in the advancing water near 68° - 30' N to melt the ice without considering the contribution of direct insolation on the ice sheet.

Farther north (in August) the mean northward velocity of water would be expected to decrease as the Chukchi Sea widens. Yet the rate of retreat of the ice commonly is greater in August than in July, indicating that the effects of insolation, both directly on the ice and on the waters to the south, are becoming increasingly important. One would then expect the zone of melt water south of the ice to widen. The results of MIZPAC 71 and MIZPAC 72 seem to confirm this idea.

It is conceivable that the ice margin controls the northward flow and some of the phenomena at the ice margin to be discussed later suggest this. The cause could be the lateral pressure of the considerable dynamic hill which develops between Bering Strait and the ice margin as a result of the melting of ice, about 6 dyn. cm.

The bottom water on the east side of Bering Strait, rather imperfectly represented by Station 18, was at 0.05° C and 33.0 o/oo, saline enough but not cold enough to form the bottom water at Station 23. However, the water at Bering Strait likely was colder at an earlier date. But, it is not justifiable to conclude that because such water

was available that it was the source water for the lower layer in the Chukchi Sea. Between Station 23 and Station 30, only 13 n mi to the north, the temperature of the bottom water drops from -1.2 to -1.72^{o} C, an abrupt change which destroys any continuity which might have been presumed to exist because of a regular flow of bottom water northward. Evidently, an abrupt modification of bottom water is taking place near the ice margin. The bottom water under the ice, with the temperature below -1.7^{o} C and salinity ordinarily greater than 33.0 o/oo, must have been in place before the retreat of the ice margin began north of Bering Strait. It may have been supplied earlier in the year through Bering Strait or it may have been formed in situ by freezing and the resulting convective overturn. The freezing point of water with a salinity of 33.0 is -1.80^{o}C. The slightly warmer water which is observed can have been formed by mixing between a more saline water at the equilibrium freezing temperature and a less saline water slightly warmer than the freezing temperature. The under-ice bottom water is near freezing, as one can see; thus it must have been formed by winter overturn, but that process can have occurred south of Bering Strait as well as in the Chukchi Sea.

Before considering the processes at the ice margin it is appropriate to complete the discussion of general oceanography, principally with reference to the character of the coastal current, and to make some estimate of the comparability of the 1974 data with earlier data.

Two crossings of the coastal region were made, one the sequence of Stations Nos. 72-75, and the other, Stations 89-94 and 102. Temperature cross-sections along these two lines are shown as Figures 4 and 5. The warmth which was expected along the coast is lacking, and a warm core of water appears to be centered beyond the stations farthest seaward, which are 40 n mi from the nearest shore. However, water of intermediate warmth extends shoreward below the surface, essentially to the most shoreward station in both figures. Figure 6 shows the horizontal distribution of the maximum temperature in the water column. This figure also indicates that to the south the warm core is more than 40 n mi from shore in latitudes between 68^{o} 30' N to 70^{o} N. In August 1971 Paquette and Bourke (1973) found the warmth closer to shore north of 70^{o} 30'. It will be seen in Figure 6 that evidence of a similar warmth, a pocket of 3^{o} water, is present close to the coast near that latitude. Thus, considering the earlier dates and consequent more southerly extent of the ice in the present cruise, it would seem that 1974 is not grossly different in character from 1971.

One cannot help being impressed by the westward extent of relatively warm water and question if this can all be supplied through the narrow eastern margin of Bering Strait. In view of the earlier calculations the answer to this is negative. Insolation must be the major cause for the warmth in the upper layer. The cold flow along the Russian coast also is strikingly narrow and seems to have a minor effect on the bulk of the Chukchi Sea water.

While we have a tendency to identify the temperature maximum with the core of a current, the reader will realize that this need not always be so. Shorefast ice which was more prevalent in 1974

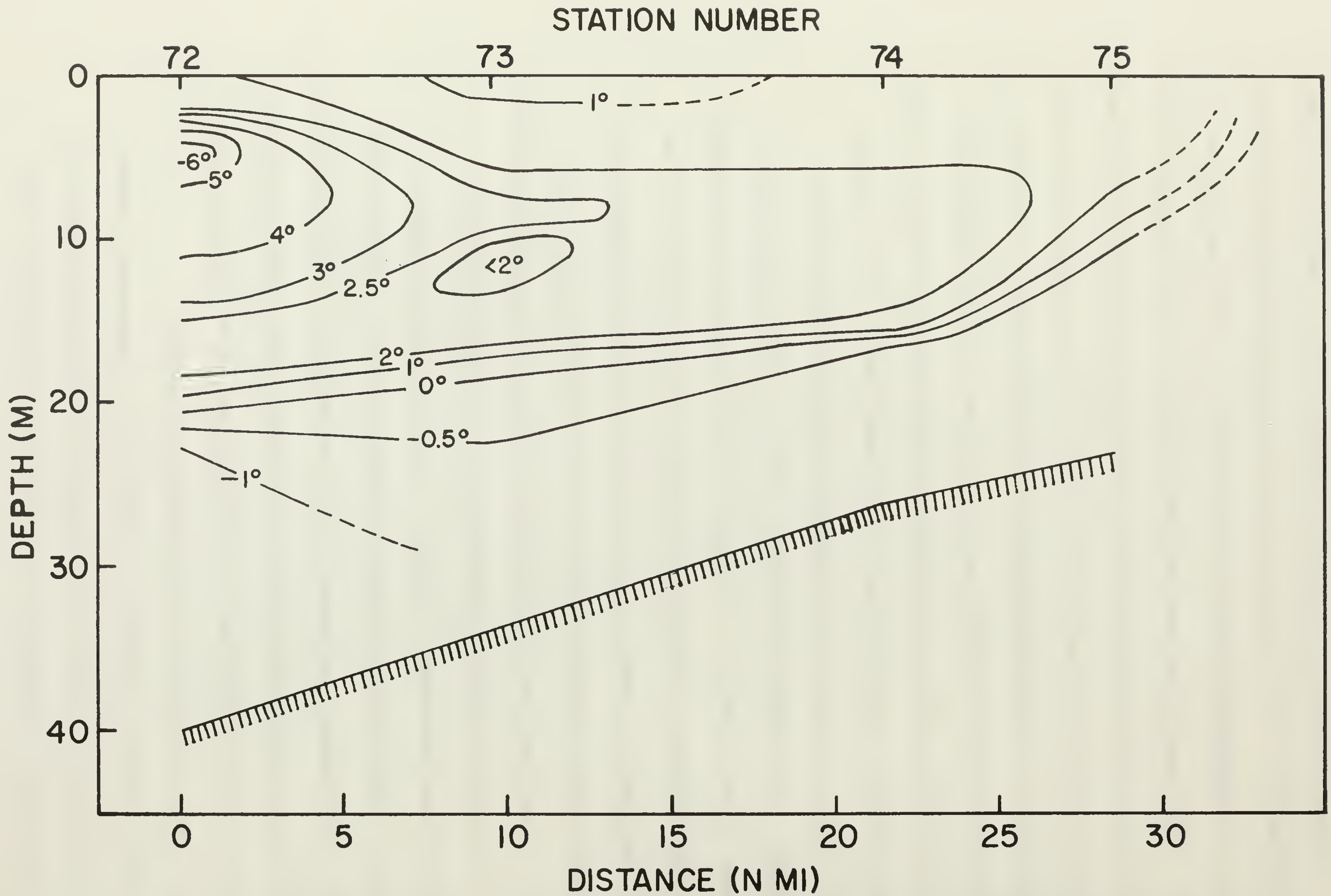


Figure 4. Temperature cross-section, Stations 72-75, across the coastal current.

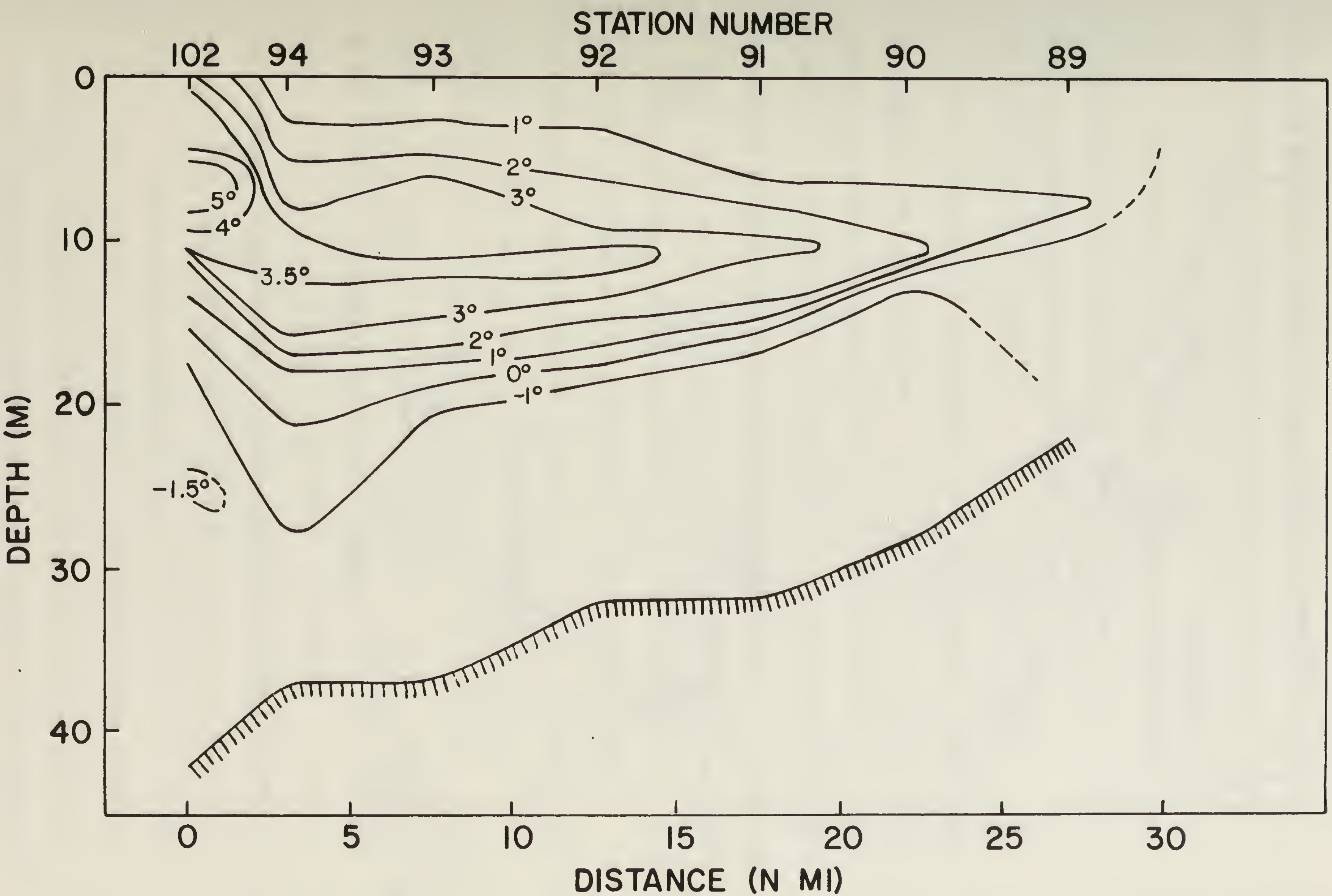


Figure 5. Temperature cross-section, Stations 89-94 and 102, across the coastal current.

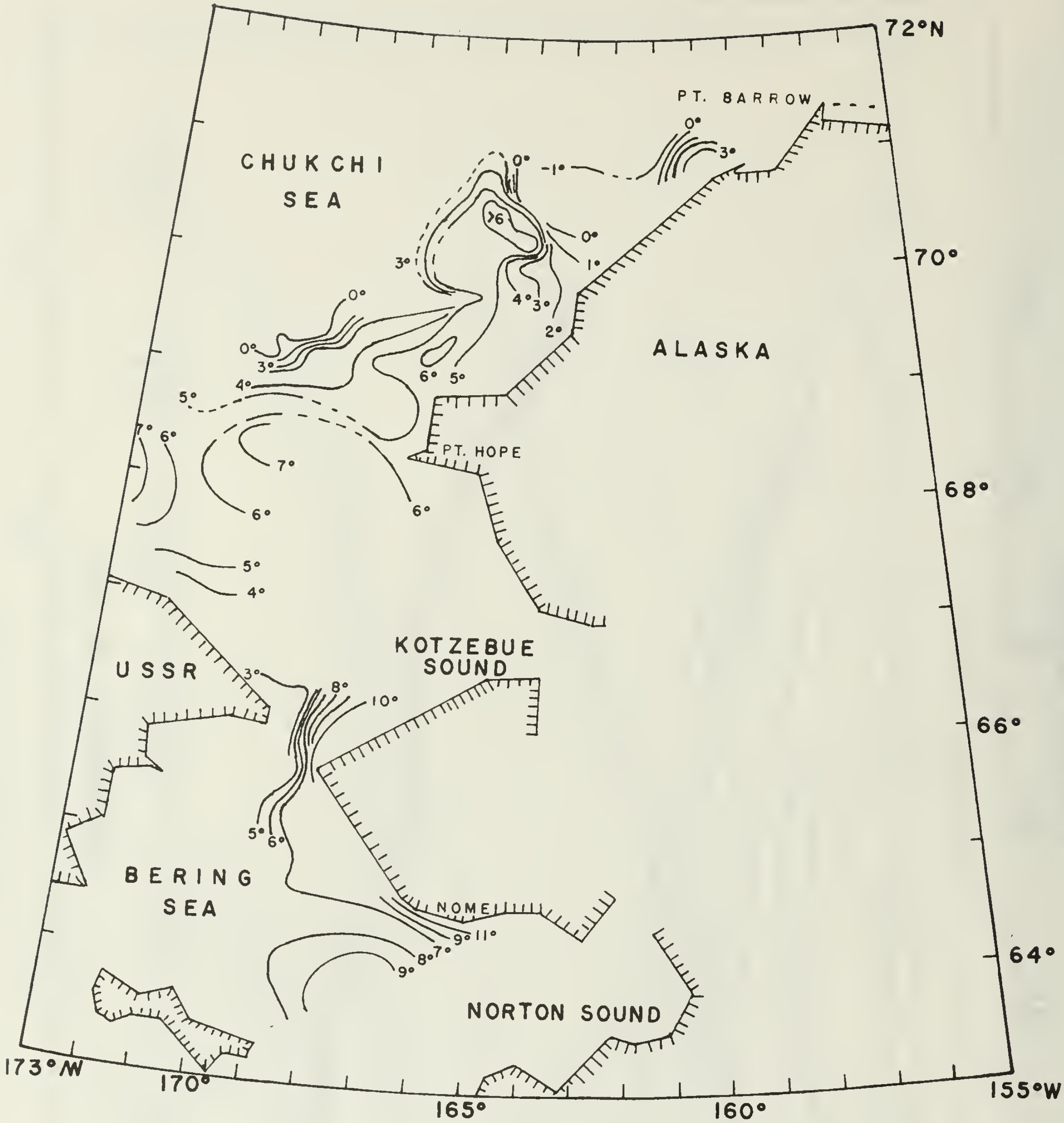


Figure 6. Map of maximum temperature in the water column.

than 1971 could, for example, have cooled the shoreward side of a warm current to yield the kind of temperature distribution shown.

There are a number of interesting questions related to the general oceanography of the Chukchi Sea, requiring more data or extensive analysis, which will be treated at a later date. These will be mentioned under Recommendations.

B. MESOSTRUCTURE

The character of the mesostructure may best be examined from the seven ice margin crossings. The first three of these contained moderate mesostructure below about 15-20 m depth whereas the remaining four had temperature profiles dominated by a shallow warm subsurface maximum with weak mesostructure in and near it. Crossings 1 and 6, which are taken as examples of the two kinds of conditions, are shown as nested temperature profiles in Figures 7 and 8. The profiles are separated by an integral number of degrees and the station number and the deepest temperature are shown at the bottom. The ice concentration is shown at the top, either in oktas or in exponential form. Temperature profiles and cross-sections of temperature and sigma-t for the other crossings are shown in Appendix IV.

Figures 9 through 12 are, respectively, temperature and sigma-t cross-sections along the line of stations in Crossings 1 and 6. The temperatures of Crossing 1 show on the left (south) the warm near-surface water typical of the area 10 or more n mi south of the ice. Further north, Crossing 1 is characterized by a complex temperature structure, warm water near the surface above a sharp thermocline, a tongue of cold water extending toward the south (left) at 5-20 m depth and an intrusion of warm water below 20 m depth which

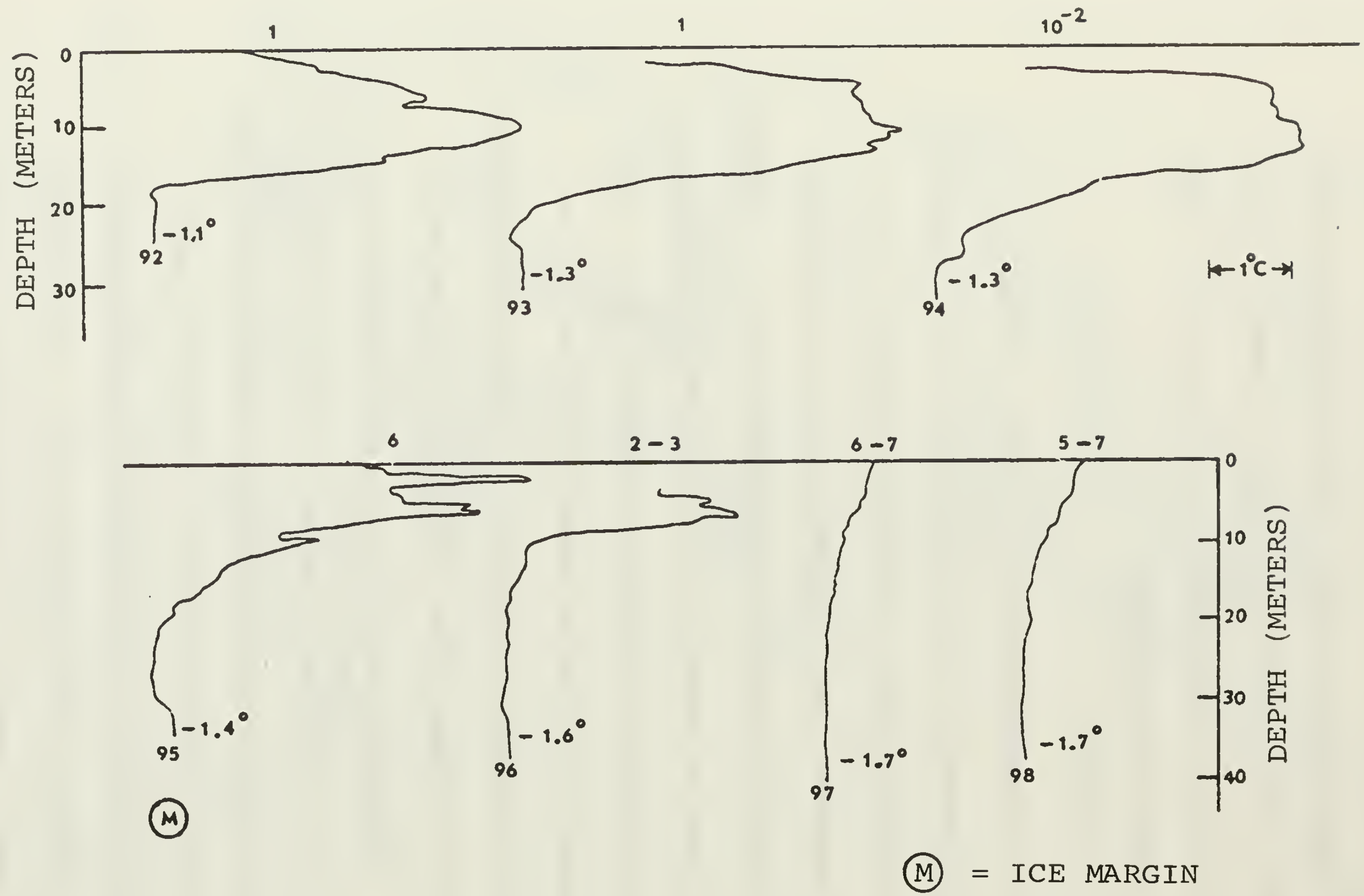
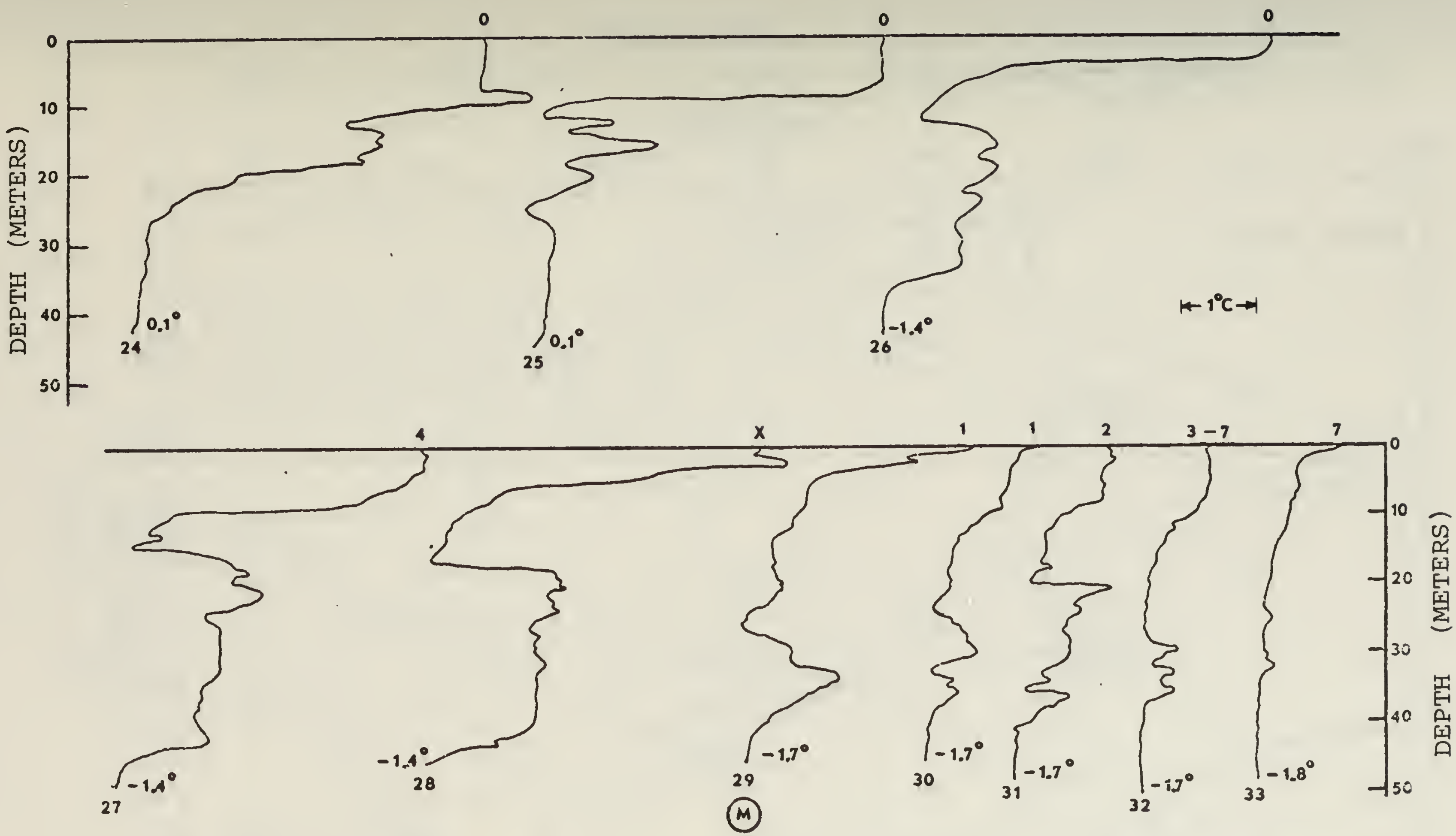


Figure 7. Nested temperature profiles for ice-margin Crossing 1. Numbers at the top of trace are ice concentrations; at the bottom of the trace the bottom temperature.



(M) = ICE MARGIN

Figure 8. Nested temperature profiles for ice-margin Crossing 6. Numbers at the top of trace are ice concentrations; at the bottom of the trace the bottom temperature.

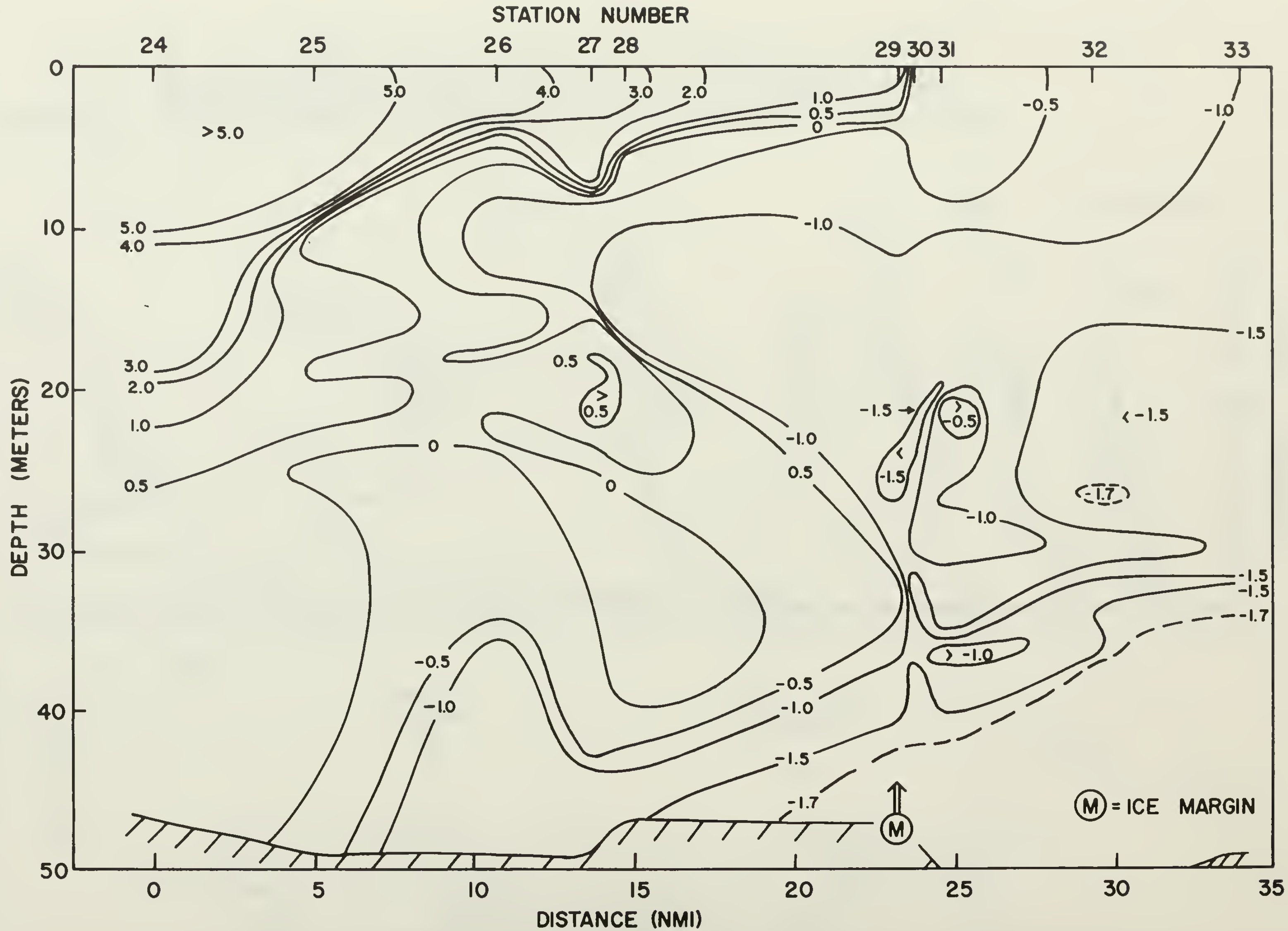


Figure 9. Temperature cross-section along ice-margin Crossing 1.

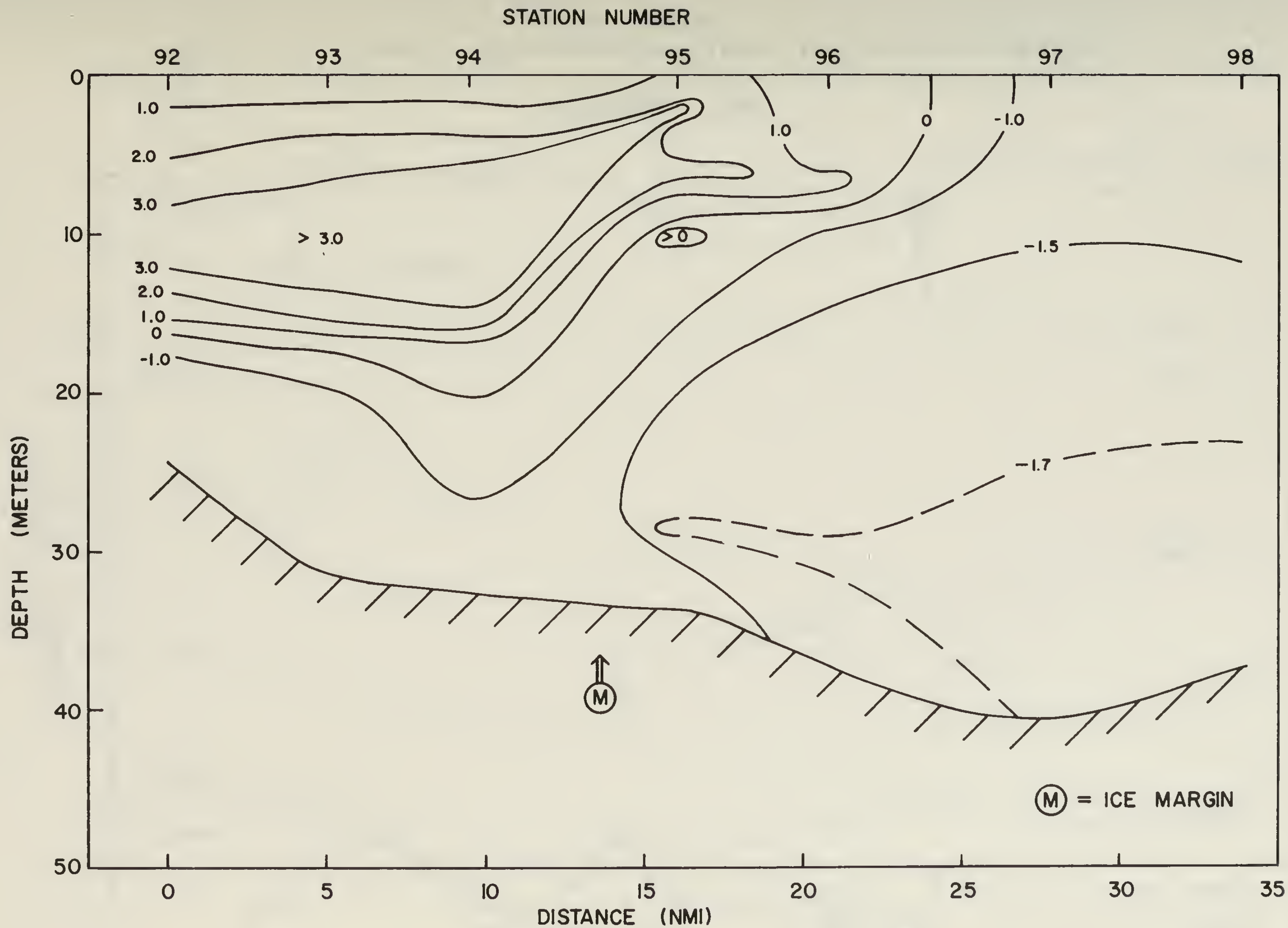


Figure 10. Temperature cross-section along ice-margin Crossing 6.

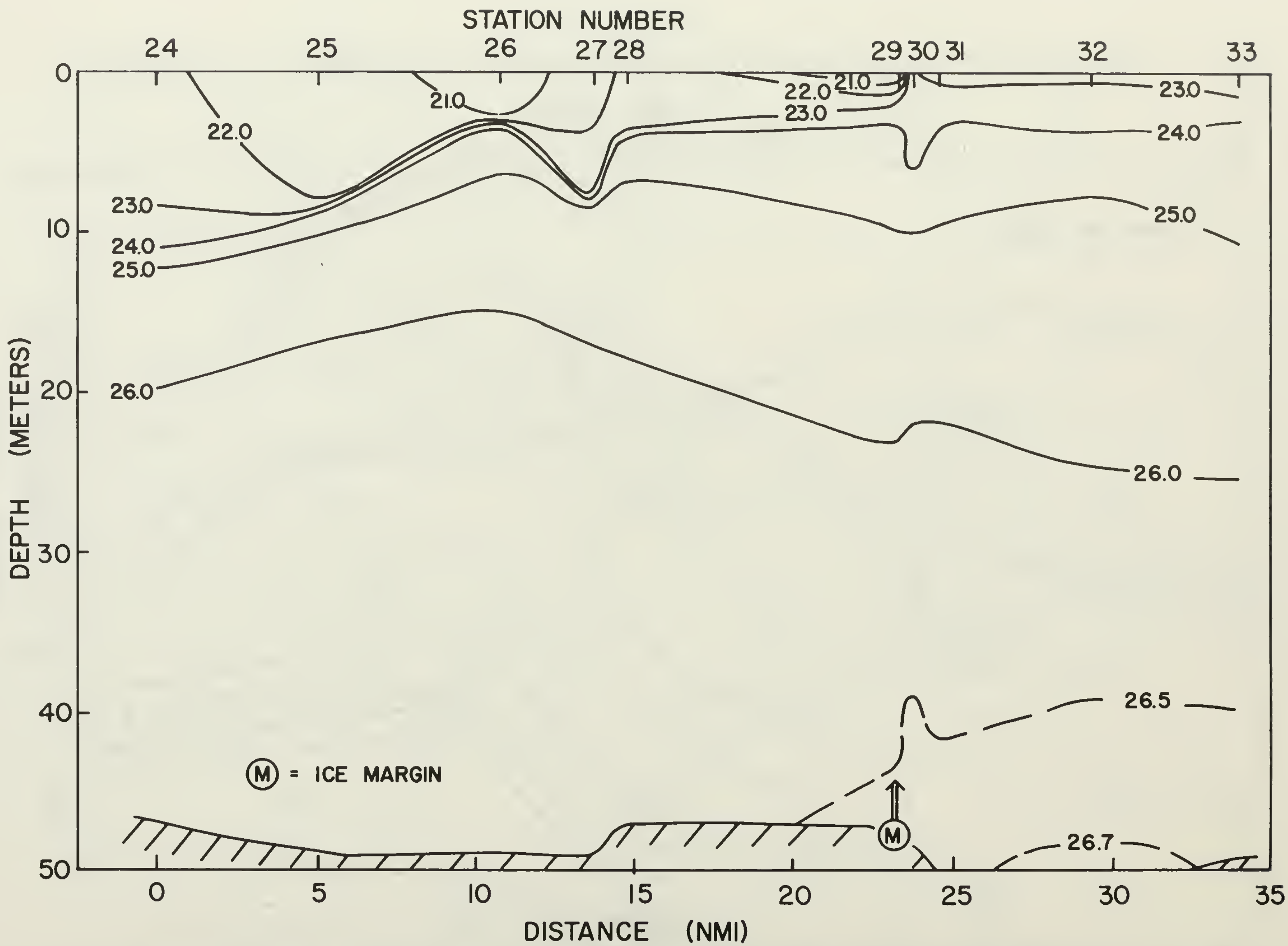


Figure 11. Sigma-t cross-section along ice-margin Crossing 1.

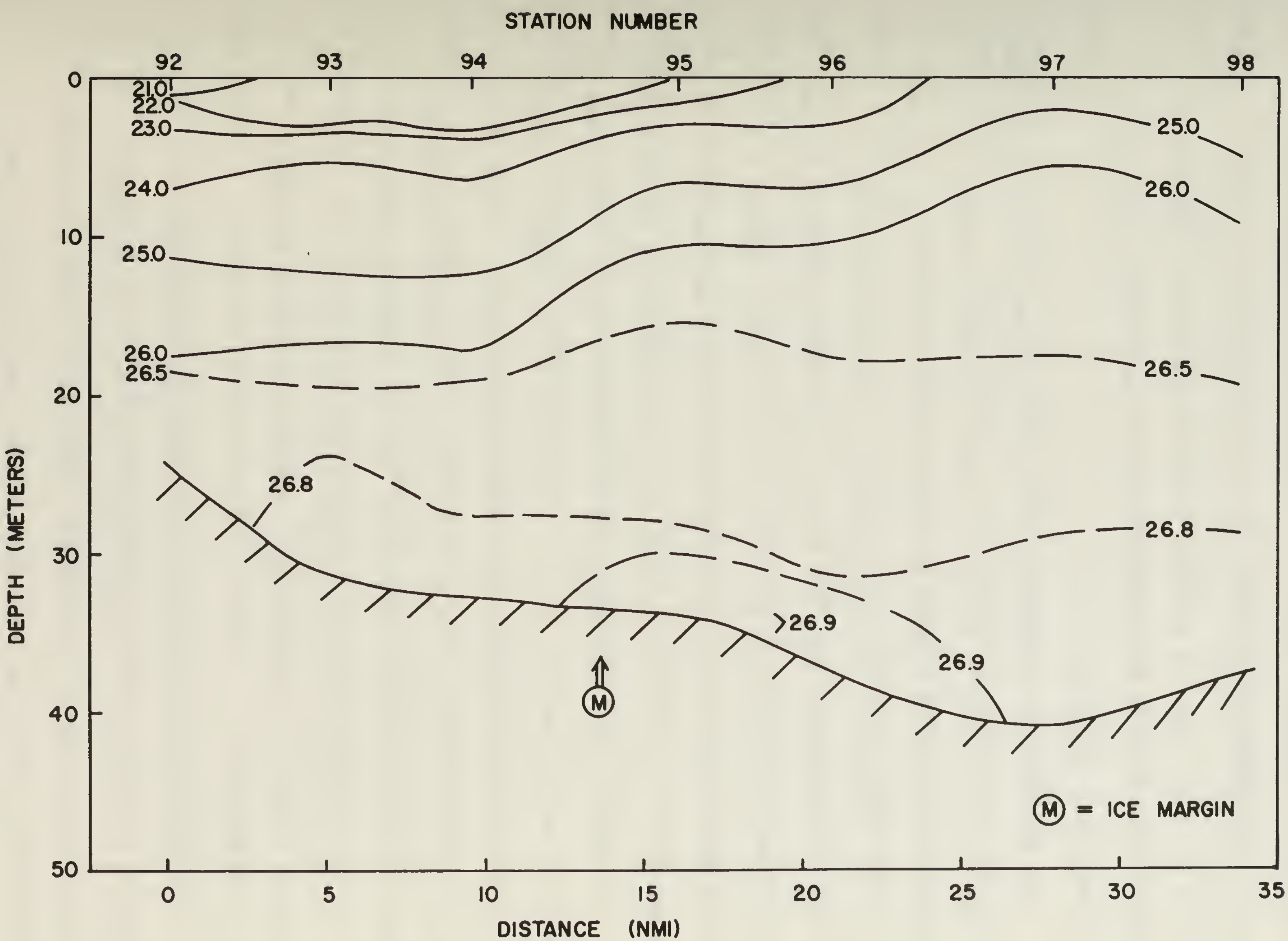


Figure 12. Sigma-t cross-section along ice-margin Crossing 6.

has warmed or displaced the -1.7^{o} C water which is present deeper in the ice. In Crossing 6 the upper warm layer appears as a tongue more than 20 m thick; there is a relatively weak thermocline beneath this tongue and the section has generally a much less complex temperature structure than Crossing 1.

The densities in Crossing 1 show a sharp pycnocline corresponding to the sharp thermocline, relatively rapid changes of density in the horizontal and notable pockets of low-density water near the surface. At the low temperatures involved, density is dependent mainly on salinity so low density near the surface represents admixture of low-salinity water from melting ice. The vertical density gradient at depths greater than 20 m is relatively low. A maximum sigma-t of 26.7 corresponds to the coldest water seen in the temperature cross-section.

The densities of Crossing 6 are different. There is much less low-density water near the surface; the densities at comparable depths are higher throughout the section and the bottom water is about 0.2 sigma-t units more dense than in Crossing 1. The vertical gradient of density near the surface is smaller than in Crossing 1,but below 15 m in the southern part it is considerably greater. In the north even the 5 m depth is included in a rather low gradient from that depth to bottom.

The difference between these two crossings corresponds to a difference in intensity of the processes involved. In Crossing 1, the upper layer appears to be driven toward the ice with sufficient velocity to mix melt-water downward and heat upward; much of the subsurface heat is utilized in melting the ice and the long wedge

of decreasing temperature consequently lies mostly outside the ice margin. Melting is taking place near the nose of the wedge where there is a pronounced lateral thermal gradient.

Beneath the warm wedge is a sharp thermocline and pycnocline which probably exists because there is a lower depth limit to the mixing processes set by the gravitational forces of the vertical density gradient. Further evidence of a relatively rapid flow toward the ice is the relatively low densities, compared with Crossing 6, in the upper layer of the ice-covered portion, indicating that diluted water is being pushed under the ice. The relatively high densities which would be expected in the upper layer south of the ice, if the flow were rapid, are obscured in Crossing 1 by a local melting process going on near Station 27 due to the presence of a patch of ice of 4 oktas concentration. The expected higher densities may be seen clearly in Crossing 2 (Appendix IV).

In Figures 7 and 9 the warm layers, as they enter the plotted sections, have already mixed to some degree with the deeper layer to destroy any sharp interface which may once have existed. However, in Crossing 6 the mixing has been much less extensive since the vertical density gradients are large. Furthermore, the densities near bottom are substantially greater in Crossing 6, indicating not only that vertical mixing is weaker, but also that lateral mixing of southerly bottom water into the area is weak. These are further evidences of relatively weak northerly flows.

Another distinction to be drawn between Crossings 1 and 6 is in the character of the mesostructure. In Crossing 1 there is principally deep mesostructure which Corse (1974) identified in MIZPAC 71 data and defined as mesostructure occurring at a sigma-t greater than 25.5. Karrer (1975), working with MIZPAC 74 data found the same kinds under similar circumstances but put the boundary between the two at 26.0 sigma-t. Crossing 6 has essentially only shallow mesostructure in and near the warm nose.

C. LATERAL MIXING PROCESSES NEAR THE ICE MARGIN

The mesostructure elements are anomalously warm lenses of water of a density appropriate to their positions at various depths in the water column. Hence, they must have part of their origin in warm surficial water or in deeper warm water to the south. As discussed below, deep structure appears to result primarily from lateral mixing of waters similar in density but different in temperature.

Figures 13 and 14 present the temperature-salinity relation for a sampling of stations in Crossings 1 and 6. A study of these diagrams gives some insight into the processes occurring, processes which are summarized graphically for Crossing 1 in Figure 15. There is little question that the warm water near the surface, upon encountering the ice, melts it and is cooled and diluted by the latent heat of freezing and the resulting melt water. A certain amount of vertical mixing must go on due to turbulence generated by ice keels interacting with flowing water which is presumed to have a component of flow toward the north. This can be seen in the decrease in density in Station 24 at depths shallower than 15 m.

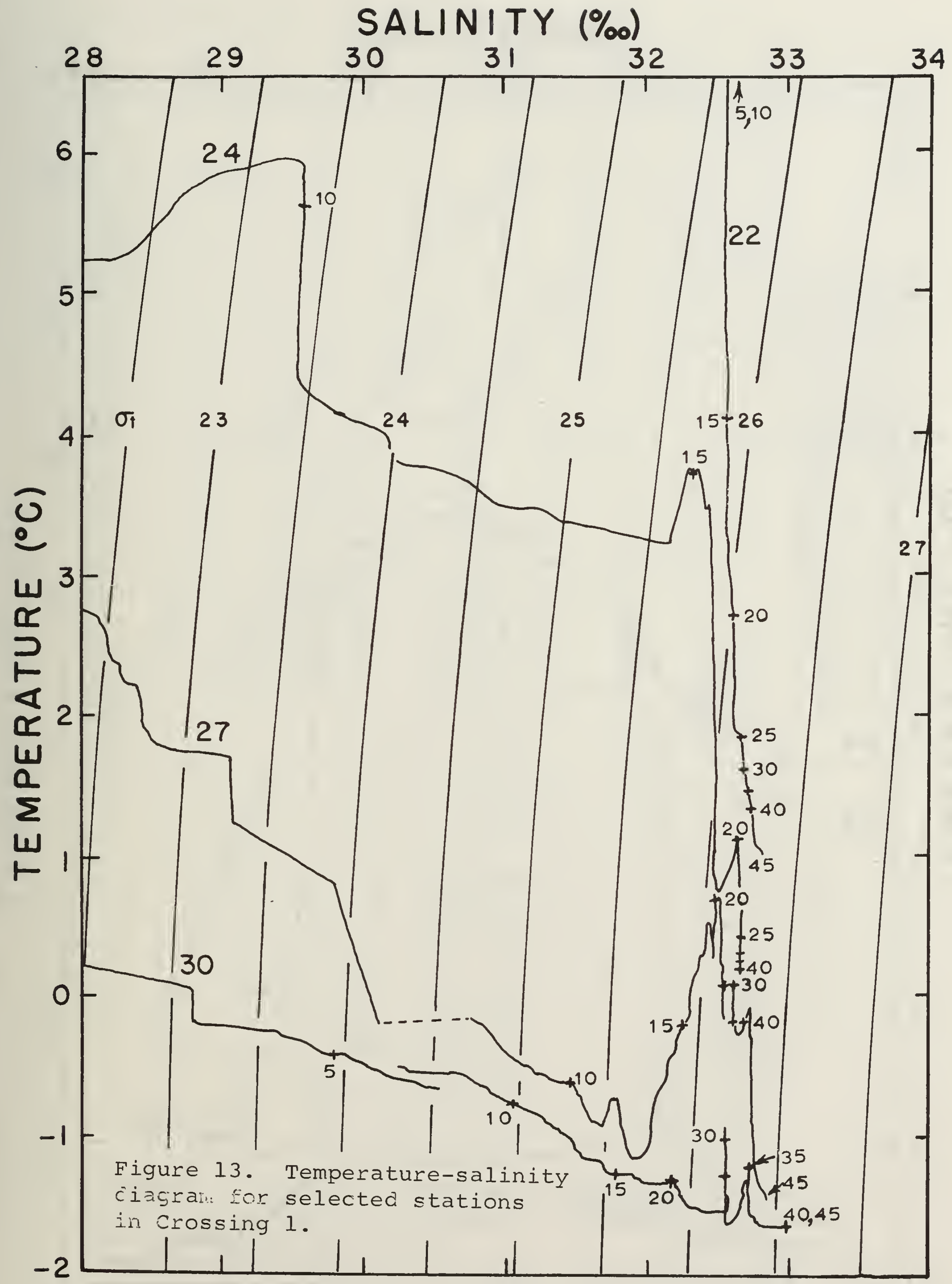


Figure 13. Temperature-salinity diagram for selected stations in Crossing 1.

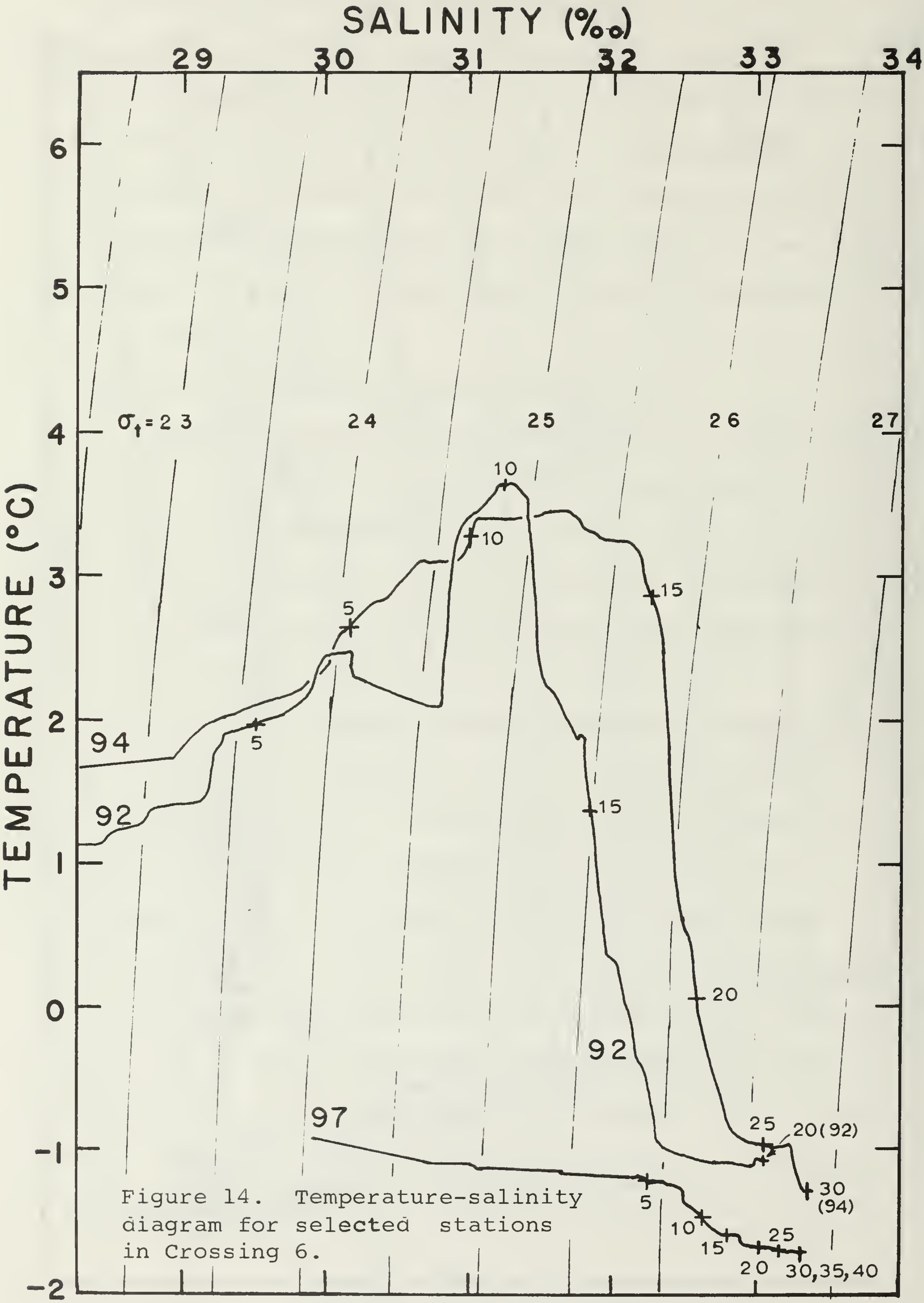


Figure 14. Temperature-salinity diagram for selected stations in Crossing 6.

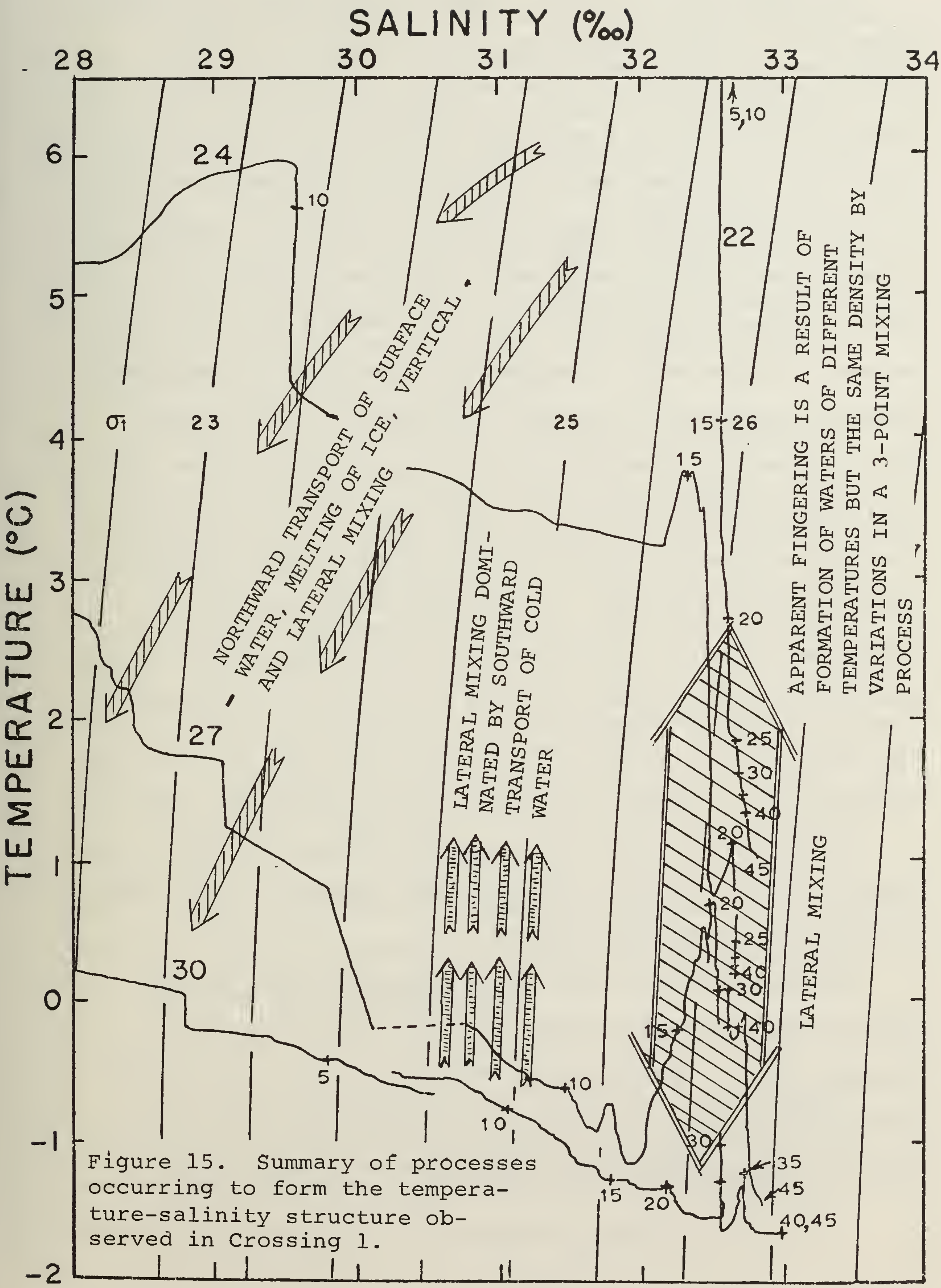


Figure 15. Summary of processes occurring to form the temperature-salinity structure observed in Crossing 1.

The mesostructure occurs in a temperature peak which can be seen to have begun to develop at Station 24 at 15 m depth. The peak is in the vicinity of the 26.0 sigma-t surface. It exists as a peak because the water between 8 and 15 m has become colder than the water below. This cooler water must be cooled basically by lateral mixing with colder water farther under the ice as at Station 30. Vertical mixing with surficial cold water would produce water which is too dilute. Vertical mixing with the cold bottom water must be ruled out because the process would be everywhere intercepted by the temperature maximum in between which would have to disappear if cold water were mixed up through it. Therefore, one is forced to the conclusion that lateral mixing is involved. The preponderance of cold water in the mixture must be due to a transport of cold northern water southward within the 8-15 m depth band. It is a matter of relative motion. Probably more likely is the assumption that flow above and below is more rapidly northward than in the 8-15 m band. A possible cause of the relative southerly flow below the thermocline is the baroclinic lateral pressure gradient which results from the admixed melt water.

From 15 m down it appears that lateral mixing along density surfaces at about a uniform rate can account adequately for the change of properties throughout the section.

Deep mesostructure is most easily envisioned as due to horizontal mixing along density surfaces. Dense, sufficiently warm, water is present in the lower layer some miles south of the ice. To produce mesostructure it has only to mix horizontally into the cold water of the <u>same</u> density under and near the ice in such a way as to

cause mixing to be grossly irregular at different depths or at different places short distances away. The moderate complexity of lateral pressure gradients might be sufficient to account for the irregularity. Or, an anomalously warm water of the same density could easily be present only a short distance away, adjacent to the oceanographic section which was measured, due to the irregularity of the ice margin, particularly if the margin is diffuse. Thus, the complexity of the temperature profile may be due more to an irregularity of the ice margin than to a complexity of the lateral mixing process.

It has occurred to us that mesostructure may not be greatly different in nature from the microstructure which frequently is found in salinity-temperature-depth recorder profiles in more southerly oceans. There the amplitudes of temperature fluctuation which can result from the mixing of two water masses are limited by the relatively small density changes which can be brought about during mixing and the relatively large area in which the density-temperature correlation is almost the same. At low temperatures, density and temperature are weakly correlated and, near the ice margin, the density-temperature relationship changes markedly within a few miles. Thus, if similar interleaving occurs in the two situations, the temperature amplitude of the anomaly can be much larger in the Chukchi Sea than in more southerly oceans.

IV. CONCLUSIONS AND RECOMMENDATIONS

A. CONCLUSIONS

In MIZPAC 74 seven ice-margin crossings with closely spaced stations were made, three of which showed deep temperature mesostructure and four did not. Those which did not tended to show a shallow warm protuberance in the temperature profile called the

"warm nose" and upon and near this nose was shallow mesostructure (sigma-t less than 25.5 to 26.0). It appears that the crossings having deep mesostructure were associated with a strong flow of warm southerly water toward the ice whereas those having the warm nose and shallow mesostructure had a weaker flow toward the ice. In the former case there appeared to be an internal vertical circulation which re-circulated a cold, somewhat diluted water southward in the upper mid-depth.

It is proposed that deep mesostructure is due to a lateral mixing process in mid-depth between a warmer southerly water and a cold under-ice water, both of nearly the same density. Temperature anomalies then result, perhaps by uneven mixing longitudinally along the direction of presumed water flow. Or, because of the irregularity of the ice margin, different mixtures may be formed at points closely adjacent to the section under measurement (hence not visible); these may then interleave under conditions requiring little lateral movement and nearly no work to be done against density forces.

It is suggested that the mesostructure of the Chukchi Sea may be analogous to some of the microstructure seen in more southerly oceans but has larger temperature amplitudes because the density-temperature relation changes so markedly over short distances in the Chukchi Sea.

Some of the general oceanography of the region north of Bering Strait has been discussed. In particular, it is found that a fairly well-defined margin, north of which there is an upper, low-salinity layer, probably marks the boundary of ice-melt water pushed northward

by the flow through Bering Strait. Further, it seems evident that both bottom water and surface water are being modified at the ice margin as the ice retreats. One must therefore use caution in tracing water types along paths which cross the ice margin. It appears that the advancing Bering Sea water is moving northward at about the same rate as the ice margin is retreating. One speculates that processes at the ice margin may control the northward flow, perhaps by means of the dynamic hill generated in the north by the melting of ice.

B. RECOMMENDATIONS

Based upon the observations and results from the three MIZPAC cruises to date there appear to be several major features relating to the character and formation of mesostructure that require explanation and further investigation in the field. For some of these features only generalizations can be inferred; the degree of variability, both temporally and spatially, may be largely unknown. For other features, e.g., the degree of compactness of the ice edge, few measurements exist, as their importance relative to mesostructure formation has only recently come to light. Some topics or features that need further investigation are:

- The occurrence of mesostructure in general. We have too few examples upon which to draw definitive conclusions. The effects of location and of season also are of interest.
- The presence of deep mesostructure in some cases and shallow mesostructure in others.
- The mixing processes occurring, particularly those at mid-depth, which create the deep mesostructure elements.

- The mechanism for the apparent southward flow of cool water at about 12-15 m depth, viz, Crossing 1, which leaves the peaks of mesostructure outstanding. This should be confirmed by direct current measurements.
- The presence and relative strength of mesostructure with regard to compactness of the ice edge.
- The relation between mesostructure strength and currents at the ice edge, especially the flow characteristics relative to the orientation of the ice edge.
- The relative position and warmth of the coastal current and its effect on mesostructure formation.
- The three-dimensional distribution of water properties in areas with mesostructure.
- The occurrence of mesostructure in waters distant (20-40 n mi) from the ice edge.
- The coupling between northward water flow and the retreat of the ice margin.
- The question of bottom water, its origins and modifications.
- Quantification of the role of solar heating in the melting processes and the role of Kotzebue Sound as a heat sink.

V. ACKNOWLEDGMENTS

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APPENDIX I

EXPLANATION OF HEADING CODES

The heading of the printed output uses the coding and format from NODC Publication M-2, August 1964, with a few exceptions. Heading entries which are not self-explanatory are as follows. MSQ is the Marsden Square, DPTH is the water depth in meters, OBS is the number of observations in the tabulation. Wave source direction is in tens of degrees, but the direction 99 indicates no observation. The significant wave height is coded by Table 10 (Code $\div$ 2 $\approx$ height in meters) and the wave period coded by Table 11 (Code $\div$ 2 $\approx$ period in sec); in each case X indicates no observation. Wind speed, V, is coded as Beaufort force, Table 17. The barometer is in millibars, less 1000 if more than 3 digits; wet and dry bulb temperatures are in degrees C. The present weather is from Table 21 with cloud type and amount from Tables 25 and 26, respectively. The combination 4 X 9 indicates that clouds cannot be observed usually because of fog conditions. The visibility is from Table 27 which is roughly in powers of two with Code 4 = 1-2 km. The ice concentration, IC, is in oktas; amounts less than 1 okta are preceded by a minus sign and indicate concentrations in powers of ten, e.g., 10^{-4} = -4.

The entry, COD, is a code to identify the method of observation taken on station: Code 1 indicates an STD observation, Code 2 a CTD observation, and Code 3 an XBT (temperature only) observation. SORD indicates a shallow shunted (S) STD lowering while D indicates a deep non-shunted STD lowering.

APPENDIX II

STD HEADING DATA AND PROPERTY PROFILES

MIZPAC 74 STD STATIONS

NAT	SHIP	LAT	LONG	MSQ	MO	DY	YR	HR	STA	DPTH	OBS	CCD	IC	WVD	HT	PER	WND	V	BAR	DRY	WET	WTHR	CL	AMT	VIS	SDRO
31	BI	64-29.0	165-25.0	233	07	13	74	18.3	001			2	0	99	X	X	99									
31	BI	64-19.0	165-56.0	233	07	15	74	02.5	002	29	635	1	0	99	X	X	99									
31	BI	64-12.0	166-24.0	233	07	15	74	04.7	003	33		2	0	99	X	X	99									
31	BI	64-01.0	167-07.5	233	07	15	74	07.0	004			2	0	99	X	X	99									
31	BI	63-51.0	167-46.0	233	07	15	74	10.0	005	37	467	1	0	99	X	X	99									
31	BI	63-39.0	168-31.0	233	07	15	74	14.0	006	37	468	1	0	99	X	X	99									
31	BI	63-59.2	168-31.8	233	07	15	74	16.6	007	40	515	1	0	29	1	X	28	2		08.5	07.9	1	8	6	8	
31	BI	64-19.4	168-31.9	233	07	15	74	19.5	008	45	594	1	0	99	X	X	99									
31	BI	64-39.2	168-32.0	233	07	15	74	22.4	009	45	573	1	0	99	X	X	99									
31	BI	64-59.2	168-32.2	233	07	16	74	01.1	010	52	703	1	0	99	X	X	99									
31	BI	65-19.0	168-32.0	233	07	16	74	01.8	011	57	776	1	0	04	2	X	03	4	010	09.0	08.2	1	7	6	8	
31	BI	65-39.8	168-32.0	233	07	16	74	06.8	012	54		2	0	99	X	X	99									
31	BI	65-57.6	168-09.0	233	07	16	74	09.6	013	54		2	0	99	X	X	99									
31	BI	66-00.4	168-20.5	233	07	16	74	11.1	014	56	755	1	0	34	0	X	34	4		06.3	05.5	1	2	2	8	
31	BI	66-02.0	168-30.0	233	07	16	74	12.6	015	56	761	1	0	99	X	X	99	0	007							
31	BI	66-16.0	168-36.0	233	07	16	74	14.4	016	56	755	1	0	99	X	X	33	1	006							
31	BI	66-26.0	168-56.0	233	07	16	74	16.5	017	59	804	1	0	35	2	X	32	4	005	07.0	05.6	1	3	1	8	
31	BI	66-57.1	170-06.5	234	07	16	74	22.4	018	48	635	1	0	99	X	X	99									
31	BI	67-25.5	171-26.5	234	07	17	74	03.9	019	48	626	1	0	04	1	X	03	3	003	06.9	06.4	1	8	1	8	
31	BI	68-00.0	172-58.0	234	07	17	74	09.2	020	50	660	1	0	99	X	X	08	3				1	7	5	8	

MIZPAC 74 STD STATIONS

NAT	SHIP	LAT	LONG	MSQ	MO	DY	YR	HR	STA	DPTH	OBS	COD	IC	WVD	HT	PER	WND	V	BAR	DRY	WET	WTHR	CL	AMT	VIS	SORD
31	BI	68-00.0	171-37.0	234	07	17	74	15.7	021	52	671	1	0	18	1	X	16	2	000	05.2	05.2	4	X	9	3	
31	BI	68-01.0	170-20.0	234	07	17	74	20.1	022	54	707	1	0	99	X	X	99									
31	BI	68-27.0	170-20.0	234	07	18	74	00.4	023	61	753	1	0	99	X	X	99	6								
31	BI	68-44.6	170-10.5	234	07	18	74	02.9	024D	55	667	1	0	99	X	X	99					2	7	8		D
31	BI	68-44.6	170-10.5	234	07	18	74	02.9	024S	55	667	1	0	99	X	X	99					2	7	8		S
31	BI	68-45.5	170-11.0	234	07	18	74	03.9	025S	57	141	1	0	18	4	X	18	5				2	7	8	8	S
31	BI	68-45.5	170-11.0	234	07	18	74	03.9	025D	57	691	1	0	18	4	X	18	5				2	7	8	8	D
31	BI	68-51.2	170-10.5	234	07	18	74	05.2	026S	57	055	1	0	18	4	X	18	5				2	7	8	8	S
31	BI	68-51.2	170-10.5	234	07	18	74	05.2	026D	57	682	1	0	18	4	X	18	5				2	7	8	8	D
31	BI	68-59.2	170-12.2	234	07	18	74	06.3	027D	57	754	1	-4	99	X	X	99									D
31	BI	68-59.2	170-12.2	234	07	18	74	06.3	027S	57	754	1	-4	99	X	X	99									S
31	BI	68-59.7	170-04.3	234	07	18	74	06.8	028S	55	104	1	-2	99	X	X	99									S
31	BI	68-59.7	170-04.3	234	07	18	74	06.8	028D	55	104	1	-2	99	X	X	99									D
31	BI	69-03.8	170-05.0	234	07	18	74	07.6	029D	55	698	1	1	99	X	X	99									D
31	BI	69-03.8	170-05.0	234	07	18	74	07.6	029S	55	133	1	1	99	X	X	99									S
31	BI	69-04.2	170-05.0	234	07	18	74	08.3	030S	56	147	1	1	99	X	X	99									S
31	BI	69-04.2	170-05.0	234	07	18	74	08.3	030D	56	706	1	1	99	X	X	99									D
31	BI	69-02.1	170-06.1	234	07	18	74	09.3	031D	58	759	1	2	99	X	X	99									D
31	BI	69-05.1	170-06.1	234	07	18	74	09.3	031S	58	108	1	2	99	X	X	99									S
31	BI	69-09.8	170-01.7	234	07	18	74	10.8	032D	62	785	1	5	99	X	X	99									D

MIZPAC 74 STD STATIONS

NAT	SHIP	LAT	LONG	MSQ	MO	DY	YR	HR	STA	DPTH	OBS	COD	IC	WVD	HT	PER	WND	V	BAR	DRY	WET	WTHR	CL	AMT	VIS	SORD
31	BI	69-09.8	170-01.7	234	07	18	74	10.8	032S	62	077	1	5	99	X	X	99									S
31	BI	69-14.5	170-03.5	234	07	18	74	12.2	033S	57	094	1	7	99	X	X	99		999							S
31	BI	69-14.5	170-03.5	234	07	18	74	12.2	033D	57	754	1	7	99	X	X	99		999							D
31	BI	69-12.0	169-06.0	233	07	18	74	19.0	034	54	716	1	0	99	X	X	99									
31	BI	69-16.9	169-02.8	233	07	18	74	20.1	035D	54	702	1	0	99	X	X	99									D
31	BI	69-16.9	169-02.8	233	07	18	74	20.1	035S	54	152	1	0	99	X	X	99									S
31	BI	69-20.8	169-06.1	233	07	18	74	21.6	036S	54	106	1	0	18	2	X	18					1	4	5	8	S
31	BI	69-20.8	169-06.1	233	07	18	74	21.6	036D	54	714	1	0	18	2	X	18					1	4	5	8	D
31	BI	69-21.5	169-06.0	233	07	18	74	23.7	037D	54	706	1	-2	18	2	X	18					1	4	5	8	D
31	BI	69-21.5	169-06.0	233	07	18	74	23.7	037S	54	140	1	-2	18	2	X	18					1	4	5	8	S
31	BI	69-23.0	169-06.0	233	07	19	74	00.7	038S	54	113	1	4	99	X	X	10	3							8	S
31	BI	69-23.0	169-06.0	233	07	19	74	00.7	038D	54	698	1	4	99	X	X	10	3							8	D
31	BI	69-24.0	169-00.0	233	07	19	74	01.7	039D	54	708	1	2	00	0	X	21	3	000		07.8	1	3	2		D
31	BI	69-24.0	169-00.0	233	07	19	74	01.7	039S	54	108	1	2	00	0	X	21	3	000		07.8	1	3	2		S
31	BI	69-25.3	168-55.1	233	07	19	74	02.8	040S	54	099	1	2	00	0	X	99	3				4	X	9		S
31	BI	69-25.3	168-55.1	233	07	19	74	02.8	040D	54	694	1	2	00	0	X	99	3				4	X	9		D
31	BI	69-33.5	168-55.1	233	07	19	74	05.6	042D	54	709	1	-2	00	0	X	34	3							2	D
31	BI	69-33.5	168-55.1	233	07	19	74	05.6	042S	54	082	1	-2	00	0	X	34	3							2	S
31	BI	69-12.8	167-36.5	233	07	19	74	12.6	043S	52	112	1	0	99	X	X	99	3	004							S
31	BI	69-12.8	167-36.5	233	07	19	74	12.6	043D	52	681	1	0	99	X	X	99	3	004							D

MIZPAC 74 STD STATIONS

NAT	SHIP	LAT	LONG	MSQ	MO	DY	YR	HR	STA	DPTH	OBS	COD	IC	WVD	HT	PER	WND	V	BAR	DRY	WET	WTHR	CL	AMT	VIS	SORD
31	BI	69-18.0	167-32.0	233	07	19	74	14.0	044	51	660	1	0	99	X	X	99	3	004							
31	BI	69-19.0	167-36.0	233	07	19	74	15.0	045	50	660	1	0	35	1	X	35	3	005		01.4	2	7	8	6	
31	BI	69-20.0	167-37.0	233	07	19	74	16.0	046	51	663	1	0	99	X	X	99				01.1					
31	BI	69-21.0	167-37.0	233	07	19	74	16.7	047	51	664	1	-3	99	X	X	99	3			00.9					
31	BI	69-21.8	167-37.0	233	07	19	74	17.5	048D	50	658	1	-3	00	0	X	99					2	7	8	8	D
31	BI	69-21.8	167-37.0	233	07	19	74	17.5	048S	50	094	1	3	00	0	X	99					2	7	8	8	S
31	BI	69-23.2	167-40.5	233	07	19	74	18.8	049S	51	043	1	0	99	0	X	99									S
31	BI	69-23.2	167-40.5	233	07	19	74	18.8	049D	51	662	1	0	99	0	X	99									D
31	BI	69-27.5	167-40.1	233	07	19	74	22.2	050D	51	664	1	3	99	X	X	99									D
31	BI	69-27.5	167-40.1	233	07	19	74	22.2	050S	51	136	1	3	99	X	X	99									S
31	BI	69-29.4	167-42.0	233	07	19	74	23.7	051S	48	140	1	2	99	X	X	99									S
31	BI	69-29.4	167-42.0	233	07	19	74	23.7	051D	48	613	1	2	99	X	X	99									D
31	BI	69-31.9	167-36.0	233	07	20	74	01.3	052D	49	646	1	2	99	X	X	99		009							D
31	BI	69-31.9	167-36.0	233	07	20	74	01.3	052S	49	119	1	2	99	X	X	99		009							S
31	BI	69-37.9	166-00.0	233	07	20	74	09.1	053	43	542	1	0	99	1	X	01	2		01.8	01.6	6		8		
31	BI	69-43.8	166-00.0	233	07	20	74	10.8	054D	43	538	1	0	99	X	X	99		010			2	7	8	8	D
31	BI	69-43.8	166-00.0	233	07	20	74	10.8	054S	43	098	1	0	99	X	X	99		010			2	7	8	8	S
31	BI	69-59.0	165-57.0	233	07	20	74	13.9	055	52	628	1	C	02	0	X	02	2		00.9	00.8	2	7	8	8	
31	BI	70-11.4	165-54.8	269	07	20	74	16.3	056	47	614	1	0	01	0	X	01	1				2	7	8	6	
31	BI	70-21.7	165-55.5	269	07	20	74	17.9	057	48	618	1	0	01	0	X	00	0							6	

MIZPAC 74 STD STATIONS

NAT	SHIP	LAT	LONG	MSQ	MO	DY	YR	HR	STA	DPTH	OBS	CCD	IC	WVD	HT	PER	WND	V	BAR	DRY	WET	WTHR	CL	AMT	VIS	SORD
31	BI	70-23.1	165-53.6	269	07	20	74	19.0	058	46	587	1	0	01	0	X	00	0							8	
31	BI	70-24.0	165-56.0	269	07	20	74	19.8	059	49	328	1	0	01	0	X	00	0								
31	BI	70-26.5	165-52.9	269	07	20	74	21.3	060	46	602	1	1	00	0	X	00	0	012						7	
31	BI	70-27.7	165-56.5	269	07	20	74	22.0	061	46	588	1	2	00	0	X	00	0				1	7	6	6	
31	BI	70-28.9	165-56.2	269	07	20	74	23.0	062	46	573	1	-4	00	0	X	36	1							7	
31	BI	70-32.3	165-59.0	269	07	21	74	00.3	063D	46	587	1	5	99	0	X	99	2	012						8	D
31	BI	70-32.3	165-59.0	269	07	21	74	00.3	063S	46	105	1	5	99	0	X	99	2	012						8	S
31	BI	70-36.8	165-58.4	269	07	21	74	02.3	064S	45	112	1	3	04	0	X	04	2	012			1	7	7	4	S
31	BI	70-36.8	165-58.4	269	07	21	74	02.3	064D	45	565	1	3	04	0	X	04	2	012			1	7	7	4	D
31	BI	70-21.5	164-24.8	269	07	21	74	09.4	065D	43	535	1	0	04	0	X	04	3				4	X	9	4	D
31	BI	70-21.5	164-24.8	269	07	21	74	09.4	065S	43	122	1	0	04	0	X	04	3				4	X	9	4	S
31	BI	70-22.4	164-24.6	269	07	21	74	10.5	066D	43	548	1	1	99	X	X	99									D
31	BI	70-22.4	164-24.6	269	07	21	74	10.5	066S	43	067	1	1	99	X	X	99									S
31	BI	70-26.0	164-24.5	269	07	21	74	11.7	067S	43	055	1	-4	00	0	X	99	3	013			1	7	6	6	S
31	BI	70-26.0	164-24.5	269	07	21	74	11.7	067D	43	549	1	-4	00	0	X	99	3	013			1	7	6	6	D
31	BI	70-26.0	164-28.0	269	07	21	74	12.7	068D	43	537	1	0	99	X	X	99									D
31	BI	70-26.0	164-28.0	269	07	21	74	12.7	068S	43	106	1	0	99	X	X	99									S
31	BI	70-28.0	164-28.4	269	07	21	74	13.6	069S	45	111	1	1	99	X	X	00	0	013			1	7	4	6	S
31	BI	70-28.0	164-28.4	269	07	21	74	13.6	069D	45	576	1	1	99	X	X	00	0	013			1	7	4	6	D
31	BI	70-31.0	164-28.0	269	07	21	74	14.7	070D	45	593	1	2	00	0	X	07	3				1	7	1	6	D

MIZPAC 74 STD STATIONS

NAT	SHIP	LAT	LONG	MSQ	MO	DY	YR	HP	STA	DPTH	OBS	CCD	IC	WVD	HT	PER	WND	V	BAR	DRY	WET	WTHR	CL	AMT	VIS	SORD
31	BI	70-31.0	164-28.0	269	07	21	74	14.7	070S	45	131	1	2	00	0	X	07	3				1	7	1	6	S
31	BI	70-34.1	164-21.0	269	07	21	74	16.4	071D	48	634	1	8	00	0	X	07	2				0		0	6	D
31	BI	70-34.1	164-21.0	269	07	21	74	16.4	071S	48	107	1	8	00	0	X	07	2				0		0	6	S
31	BI	70-11.6	164-26.8	269	07	21	74	20.3	072D	40	518	1	0	99	0	X	35	4	014			0		0	8	D
31	BI	70-11.6	164-26.8	269	07	21	74	20.3	072S	40	054	1	0	99	0	X	35	4	014			0		0	8	S
31	BI	70-07.9	164-00.3	269	07	21	74	22.8	073S	34	082	1	7	00	0	X	99		014			0		0	8	S
31	BI	70-07.9	164-00.3	269	07	21	74	22.8	073D	34	419	1	7	00	0	X	99		014			0		0	8	D
31	BI	70-03.6	163-43.5	269	07	22	74	00.3	074	26	307	1	4	99	X	X	99	3	014			0		0	8	
31	BI	69-54.4	163-18.9	233	07	22	74	01.6	075	23	255	1	-2	99	X	X	99									
31	BI	67-48.0	165-57.0	233	07	22	74	19.9	076	48	661	1	0	99	2	X	13	5				0		0	8	
31	BI	68-23.5	167-38.4	233	07	23	74	18.6	077	51	702	1	0	99	0	X	99	2				0		0	8	
31	BI	68-34.0	167-24.5	233	07	23	74	20.2	077A	48	583	1	0	99	X	X	99					0		0	8	A
31	BI	68-50.0	167-05.5	233	07	23	74	22.5	078	44	580	1	0	99	0	X	00	0	005			1	7	3	8	
31	BI	69-16.2	166-17.5	233	07	24	74	01.8	079	35	428	1	0	00	0	X	00	0	004			0		0	8	
31	BI	69-33.4	165-24.8	233	07	24	74	05.2	080	36	471	1	0	27	0	X	27	2	004			0		0	8	
31	BI	69-51.6	164-35.8	233	07	24	74	08.8	081	34	413	1	-6	30	0	X	00	0	004			1	0	1	8	
31	BI	70-01.2	164-16.2	269	07	24	74	10.9	082D	32	393	1	1	00	0	X	99	3	003							D
31	BI	70-01.2	164-16.2	269	07	24	74	10.9	082S	32	076	1	1	00	0	X	99	3	003							S
31	BI	70-03.8	164-03.4	269	07	24	74	12.4	083S	32	101	1	1	99	X	X	99						7	3	8	S
31	BI	70-03.8	164-03.4	269	07	24	74	12.4	083D	32	396	1	1	99	X	X	99						7	3	8	D

MIZPAC 74 STD STATIONS

NAT	SHIP	LAT	LONG	MSQ	MO	DY	YR	HR	STA	DPTH	OBS	COD	IC	WVD	HT	PER	WND	V	BAR	DRY	WET	WTHR	CL	AMT	VIS	SORD
31	BI	70-07.5	164-02.0	269	07	24	74	13.9	084D	35	443	1	1	99	X	X	99		003				7	3	8	D
31	BI	70-07.5	164-02.0	269	07	24	74	13.9	084S	35	143	1	1	99	X	X	99						7	3	8	S
31	BI	70-09.8	163-55.0	269	07	24	74	15.1	085S	35	130	1	1	99	0	X	20	4	004			1	2	6	8	S
31	BI	70-09.8	163-55.0	269	07	24	74	15.1	085D	35	463	1	1	99	0	X	20	4	004			1	2	6	8	D
31	BI	70-13.8	163-45.0	269	07	24	74	16.6	086D	35	438	1	4	00	0	X	19	3				1	2	6	7	D
31	BI	70-13.8	163-45.0	269	07	24	74	16.6	086S	35	104	1	4	00	0	X	19	3				1	2	6	7	S
31	BI	70-17.8	163-33.0	269	07	24	74	17.7	087S	34	092	1	7	00	0	X	99									S
31	BI	70-17.8	163-33.0	269	07	24	74	17.7	087D	34	420	1	7	00	0	X	99									D
31	BI	70-25.3	163-11.1	269	07	24	74	19.5	088D	35	448	1	7	00	0	X	99	4	003			1	0	2	8	D
31	BI	70-25.3	163-11.1	269	07	24	74	19.5	088S	35	070	1	7	00	0	X	99	4	003			1	0	2	8	S
31	BI	70-06.4	163-01.3	269	07	24	74	23.6	089S	22	090	1	1	00	0	X	99	4	004	06.4	05.1	1	2	6	8	S
31	BI	70-06.4	163-01.3	269	07	24	74	23.6	089D	22	235	1	1	00	0	X	99	4	004	06.4	05.1	1	2	6	8	D
31	BI	70-10.0	163-12.5	269	07	25	74	00.5	090D	28	320	1	-2	00	0	X	99	1	004			1	2	3	8	D
31	BI	70-10.0	163-12.5	269	07	25	74	00.5	090S	28	141	1	-2	00	0	X	99	1	004			1	2	3	8	S
31	BI	70-12.9	163-24.0	269	07	25	74	02.7	091S	32	138	1	-3	99	X	X	99									S
31	BI	70-12.9	163-24.0	269	07	25	74	02.7	091D	32	382	1	-3	99	X	X	99									D
31	BI	70-15.8	163-34.8	269	07	25	74	04.3	092D	32	380	1	1	00	0	X	34	2				1	2	5	6	D
31	BI	70-15.8	163-34.8	269	07	25	74	04.3	092S	32	380	1	1	00	0	X	34	2				1	2	5	6	S
31	BI	70-20.0	163-44.5	269	07	25	74	06.4	093S	37	095	1	1	99	X	X	20	5	004							S
31	BI	70-20.0	163-44.5	269	07	25	74	06.4	093D	37	485	1	1	99	X	X	20	5	004							D

MIZPAC 74 STD STATIONS

NAT	SHIP	LAT	LONG	MSQ	MO	DY	YR	HR	STA	DPTH	OBS	CCD	IC	WVD	HT	PER	WND	V	BAR	DRY	WET	WTHR	CL	AMT	VIS	SORD
31	BI	70-23.8	163-48.7	269	07	25	74	07.5	094D	37	520	1	-2	20	3	X	20	4	005							D
31	BI	70-23.8	163-48.7	269	07	25	74	07.5	094S	37	141	1	-2	20	3	X	20	4	005							S
31	BI	70-29.4	163-50.0	269	07	25	74	08.7	095S	40	087	1	3	00	0	X	99									S
31	BI	70-29.4	163-50.0	269	07	25	74	08.7	095D	40	087	1	3	00	0	X	99									D
31	BI	70-33.6	163-30.0	269	07	25	74	09.8	096	43	584	1	3	00	0	X	18	4								
31	BI	70-43.4	163-30.9	269	07	25	74	11.3	097	46	635	1	7	00	0	X	99	4	006	03.1	03.0	4	X	9	6	
31	BI	70-41.0	163-12.5	269	07	25	74	12.8	098D	43	586	1	7	00	0	X	20	0	006			2	7	8	7	D
31	BI	70-41.0	163-12.5	269	07	25	74	12.8	098S	43	050	1	7	00	0	X	20	5	006			2	7	8	7	S
31	BI	70-37.0	162-49.6	269	07	25	74	13.7	099S	43	087	1	3	00	0	X	18	6				2	7	8	7	S
31	BI	70-37.0	162-49.8	269	07	25	74	13.7	099D	43	415	1	3	00	0	X	18	6				2	7	8	7	D
31	BI	70-37.3	162-39.7	269	07	25	74	14.6	100D	42	578	1	7	00	0	X	21	6			05.3	2	3	8	7	D
31	BI	70-37.3	162-39.7	269	07	25	74	14.6	100S	42	049	1	7	00	0	X	21	6			05.3	2	3	8	7	S
31	BI	70-37.7	162-31.4	269	07	25	74	15.9	101S	41	075	1	6	00	0	X	22	3	008		03.5	2	3	8	7	S
31	BI	70-37.7	162-31.4	269	07	25	74	15.9	101D	41	552	1	6	00	0	X	22	3		00.8	03.5	2	3	8	7	D
31	BI	70-25.1	163-56.1	269	07	26	74	02.7	102	42	545	1	0	99	4	X	20	4				6	6	8	6	
31	BI	70-36.6	163-56.3	269	07	26	74	04.3	103D	48	674	1	0	99	4	X	19	3			02.3	4	X	9	4	D
31	BI	70-36.6	163-56.3	269	07	26	74	04.3	103S	48	674	1	0	99	4	X	19	3			02.3	4	X	9	4	S
31	BI	70-37.6	163-47.5	269	07	26	74	05.4	104	48	684	1	8	99	2	X	99	2		02.4	02.3	4	X	9	4	
31	BI	70-26.3	165-01.3	269	07	26	74	14.0	105	46	603	1	0	99	X	X	21	4	009			6				
31	BI	70-26.5	165-04.0	269	07	26	74	14.9	106	45	562	1	-2	99	2	X	99	4				4	X	9	4	

MIZPAC 74 STD STATIONS

NAT	SHIP	LAT	LONG	MSQ	MO	DY	YR	HR	STA	DPTH	OBS	COD	IC	WVD	HT	PER	WND	V	BAR	DRY	WET	WTHR	CL	AMT	VIS	SORD
31	BI	70-31.6	165-13.3	269	07	26	74	16.0	107	46	609	1	2	21	2	X	21	4				4	X	9	3	
31	BI	70-36.5	165-14.5	269	07	26	74	17.4	108D	45	599	1	0	21	0	X	99	3				4	X	9	3	D
31	BI	70-36.5	165-14.5	269	07	26	74	17.4	108S	45	599	1	0	21	0	X	99	3				4	X	9	3	S
31	B!	70-40.0	165-14.6	269	07	26	74	18.5	109S	46	164	1	0	99	X	X	99	4				4	X	9	3	S
31	BI	70-40.0	165-14.6	269	07	26	74	18.5	109D	46	615	1	0	99	X	X	99	4				4	X	9	3	D
31	BI	70-43.9	165-17.0	269	07	26	74	19.5	110D	44	596	1	-4	18	1	X	18	3	010			4	X	9	6	D
31	BI	70-43.9	165-17.0	269	07	26	74	19.5	110S	44	141	1	-4	18	1	X	18	3	010			4	X	9	6	S
31	BI	70-44.9	165-16.5	269	07	26	74	20.2	111S	44	104	1	1	99	X	X	18	2	010			1	8	6	6	S
31	BI	70-44.9	165-16.5	269	07	26	74	20.2	111D	44	600	1	1	99	X	X	18	2	010			1	8	6	6	D

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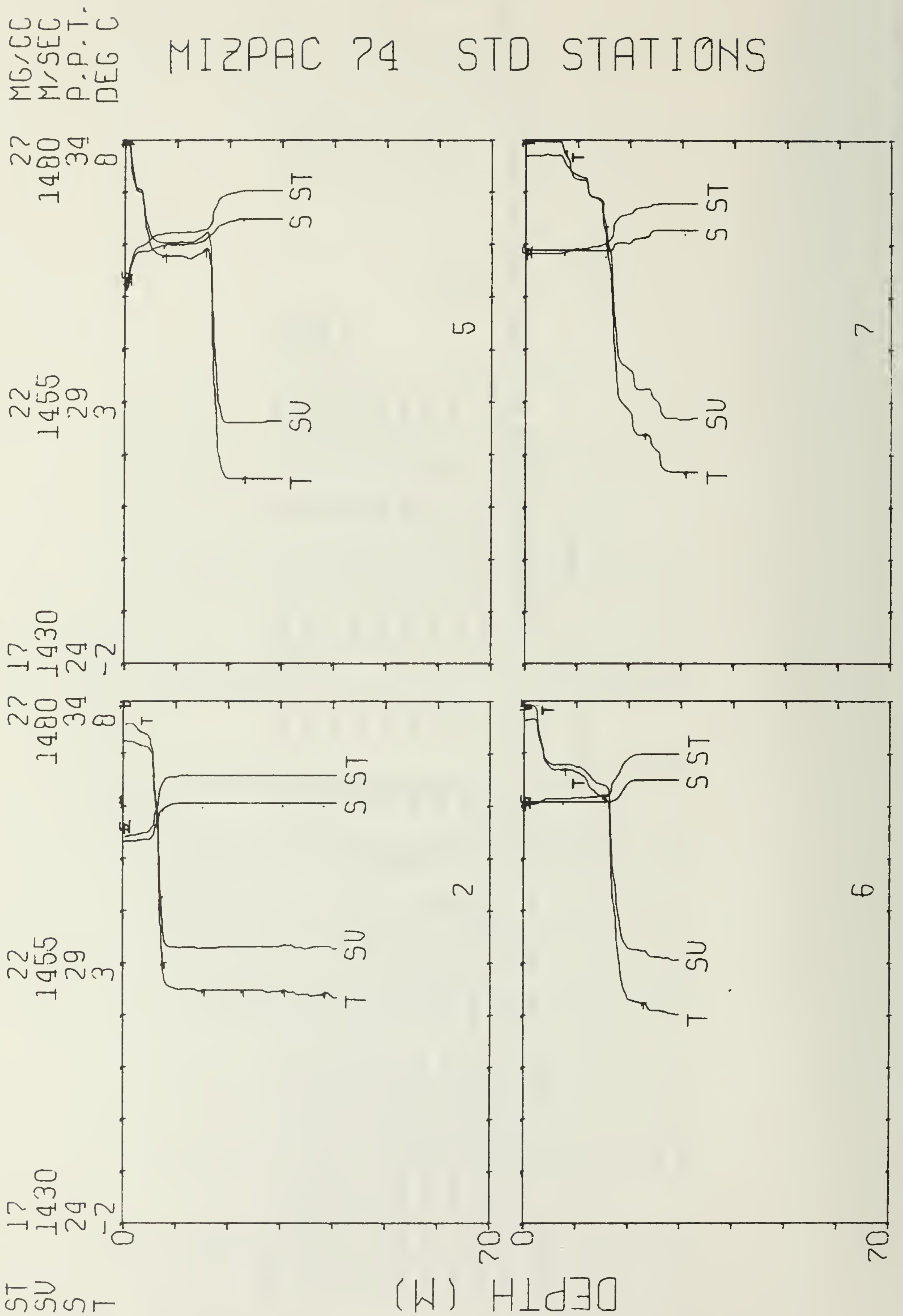
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22 1455 29 3
22 1480 34 8
DEPTH (M)
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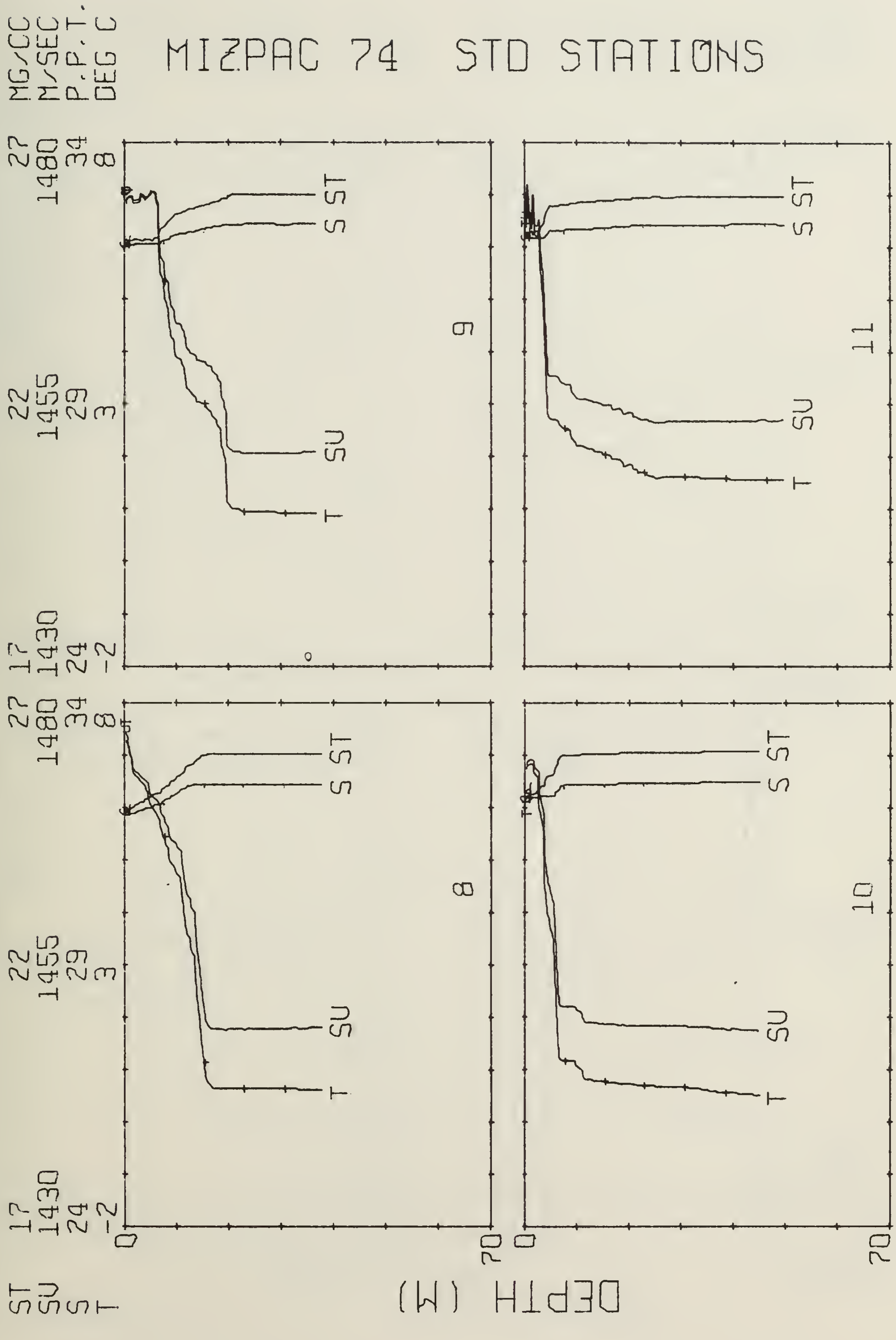
70
5
7
2
6
S ST
SU
T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DEPTH (M)
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S ST
S
SU
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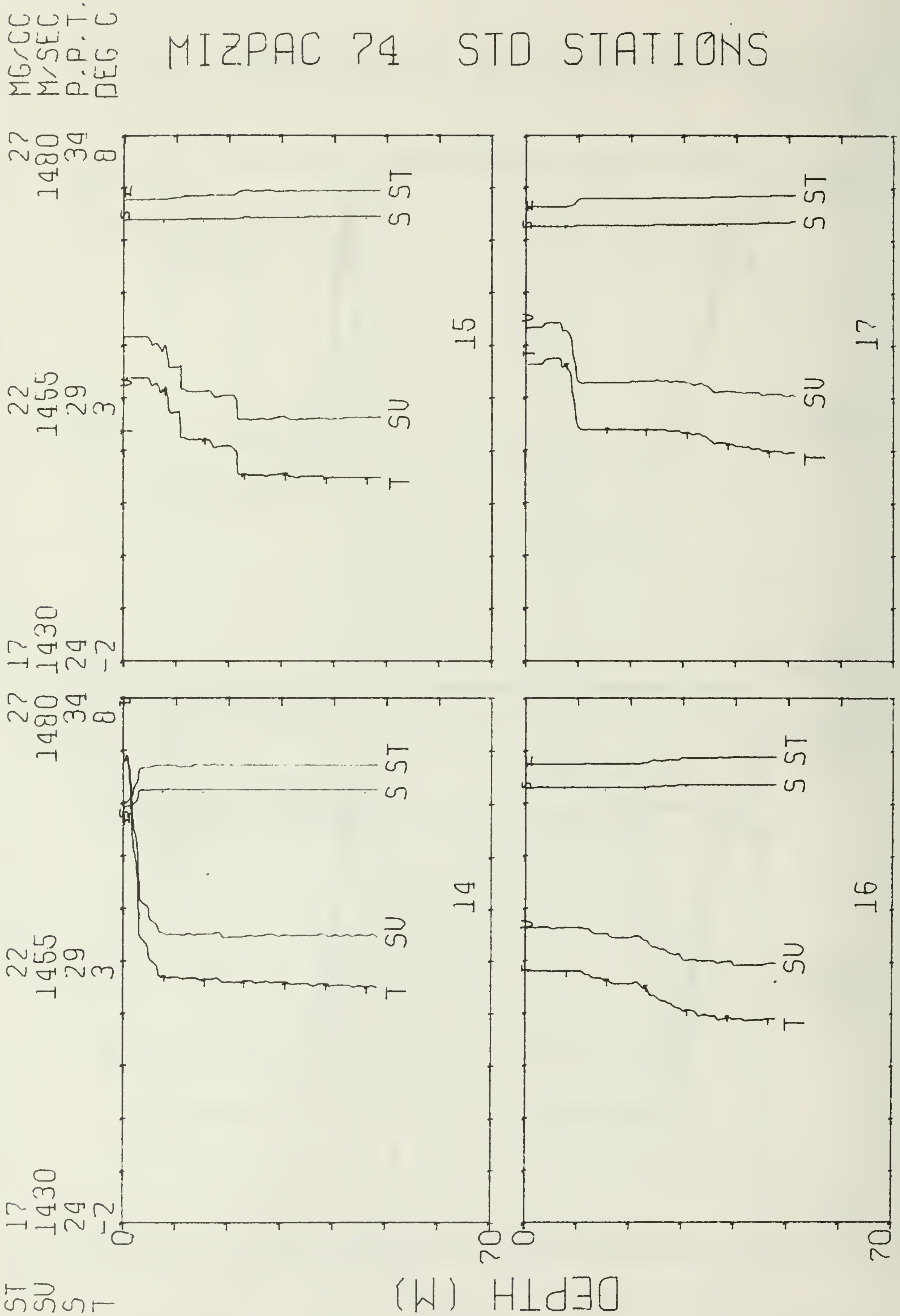
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ST SU S T
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DEPTH (M)
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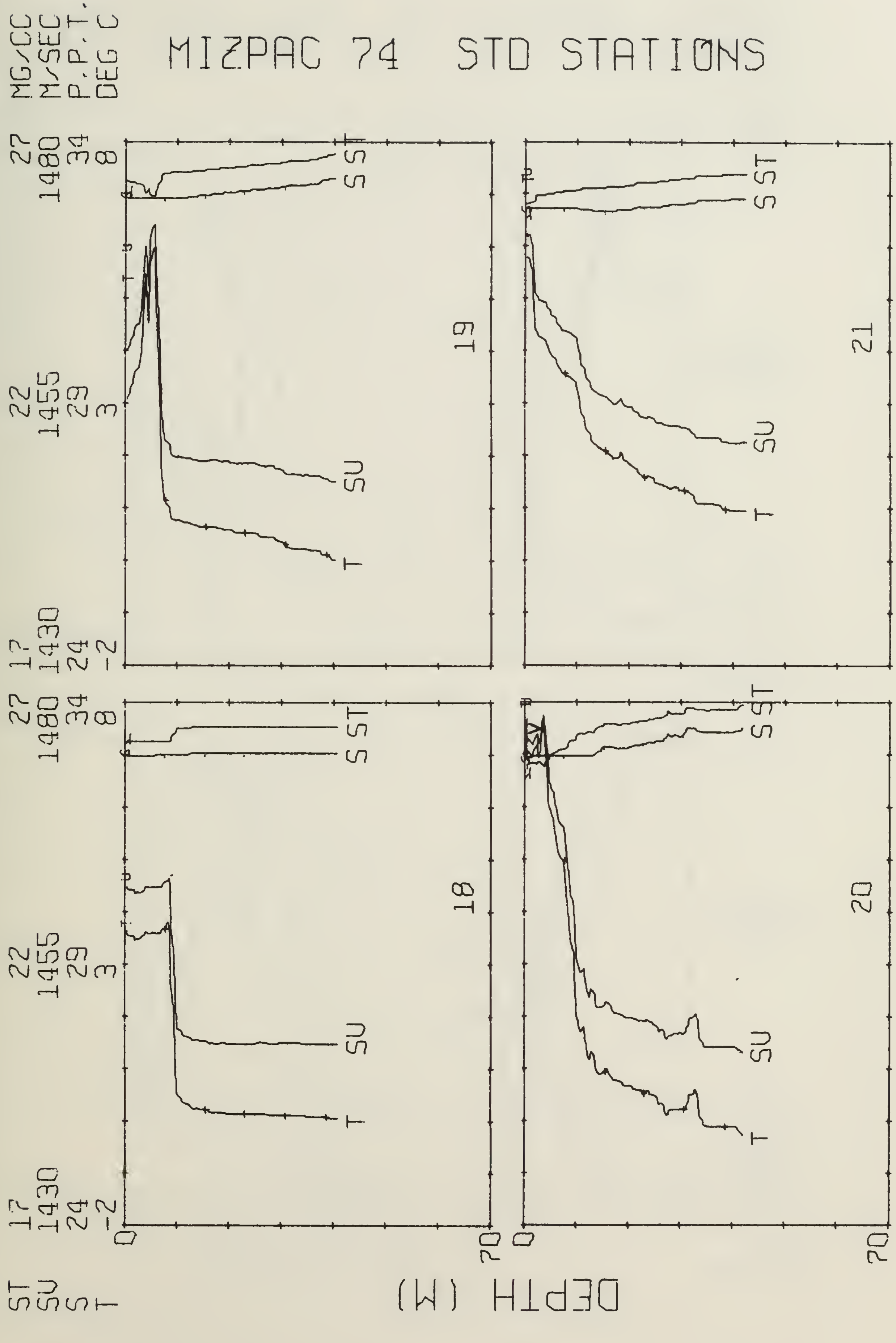
70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MG/CC
M/SEC
P.P.T.
DEG C
ST
SU
S
T
DEPTH (M)
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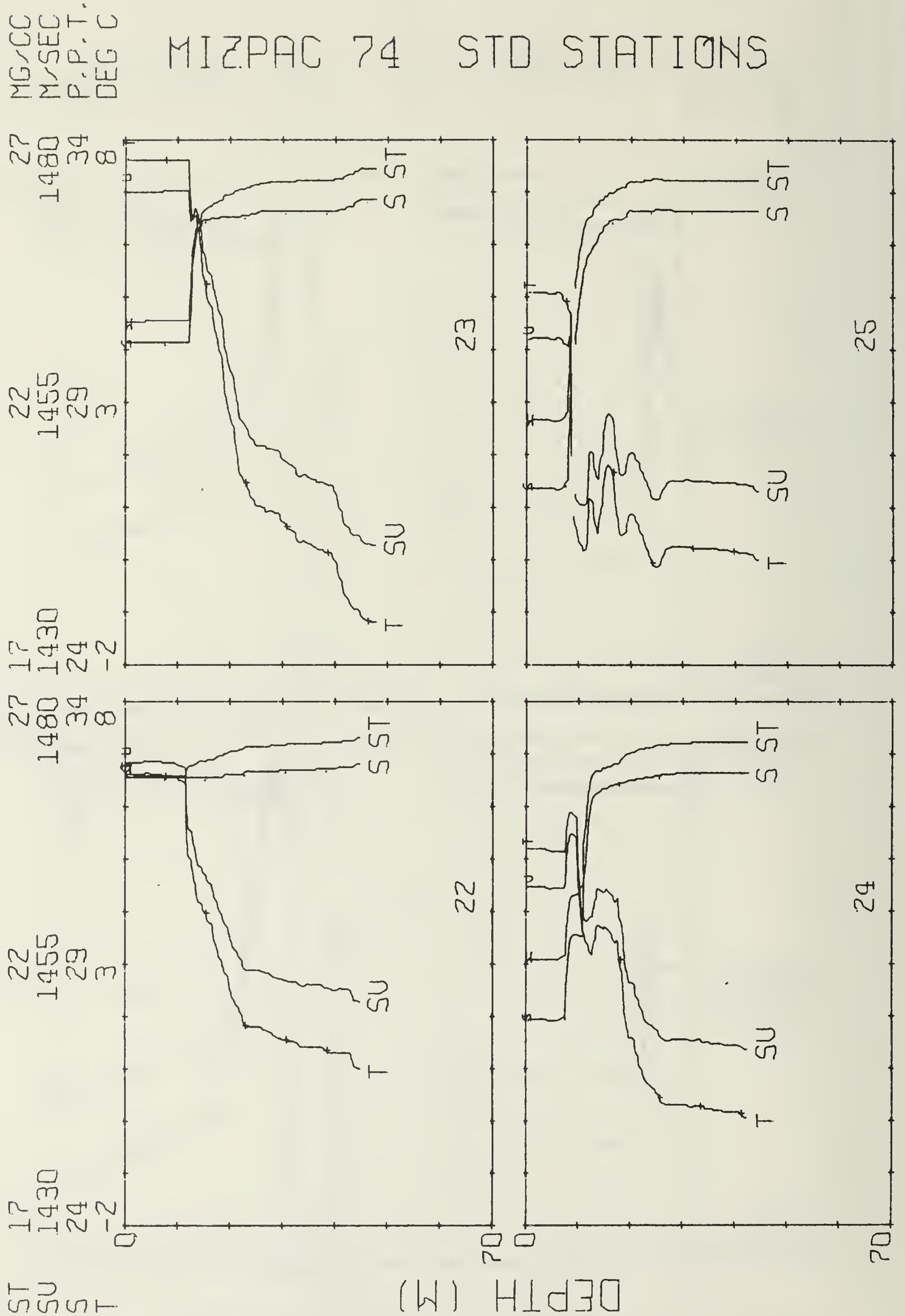
20
21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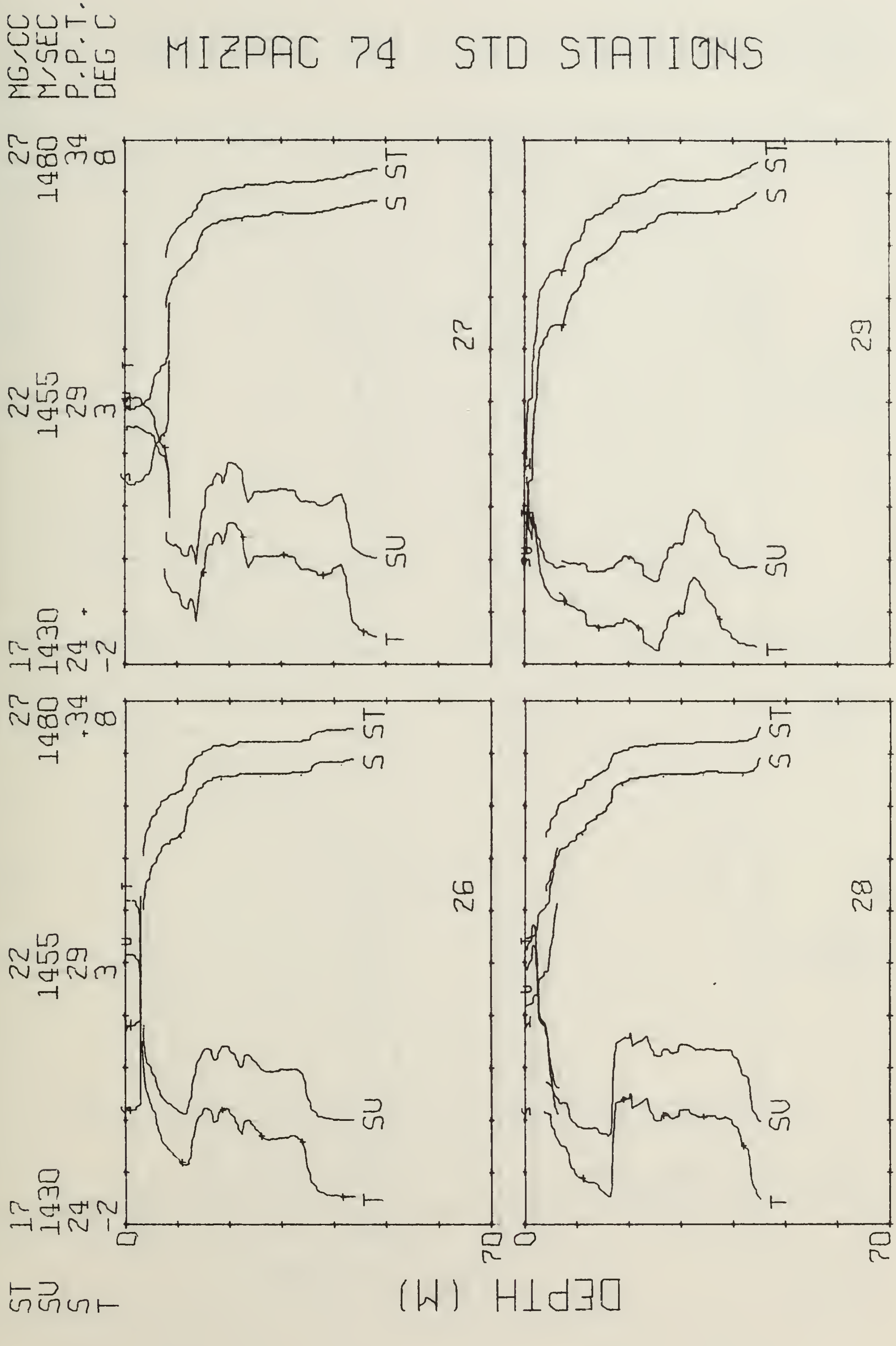
MG/CC
M/SEC
P.P.T.
DEG C
ST
SU
S
T
DEPTH (M)
23
25
22
24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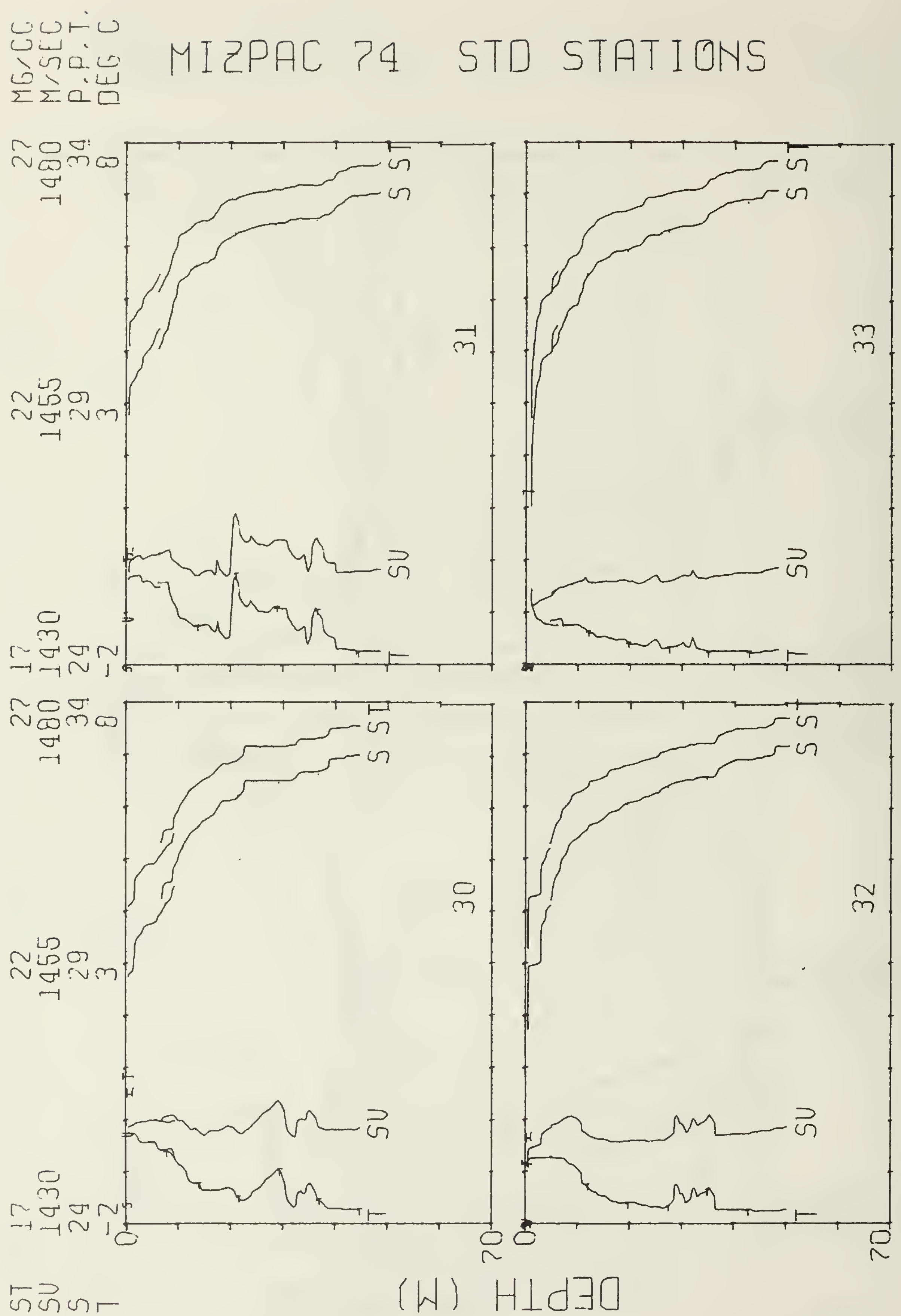
MG/CC
M/SEC
P.P.T.
DEG C
ST
SU
S
T
DEPTH (M)
26
27
28
29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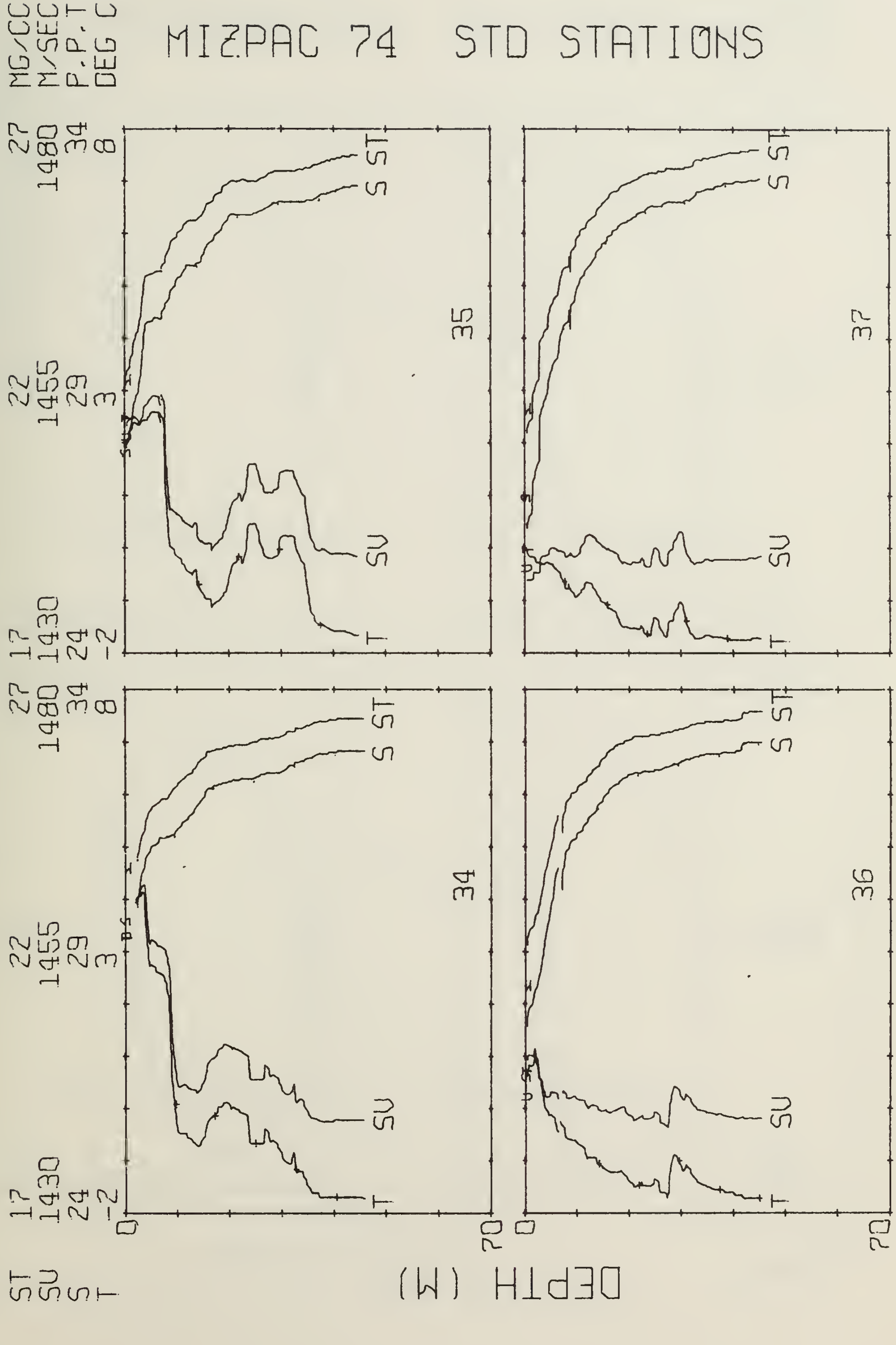
MG/CC
M/SEC
P.P.T.
DEG C
ST
SV
S
T
17 1430 24 -2
22 1455 29 3
27 1480 34 8
DEPTH (M)
0
70
30
31
32
33
SU
S ST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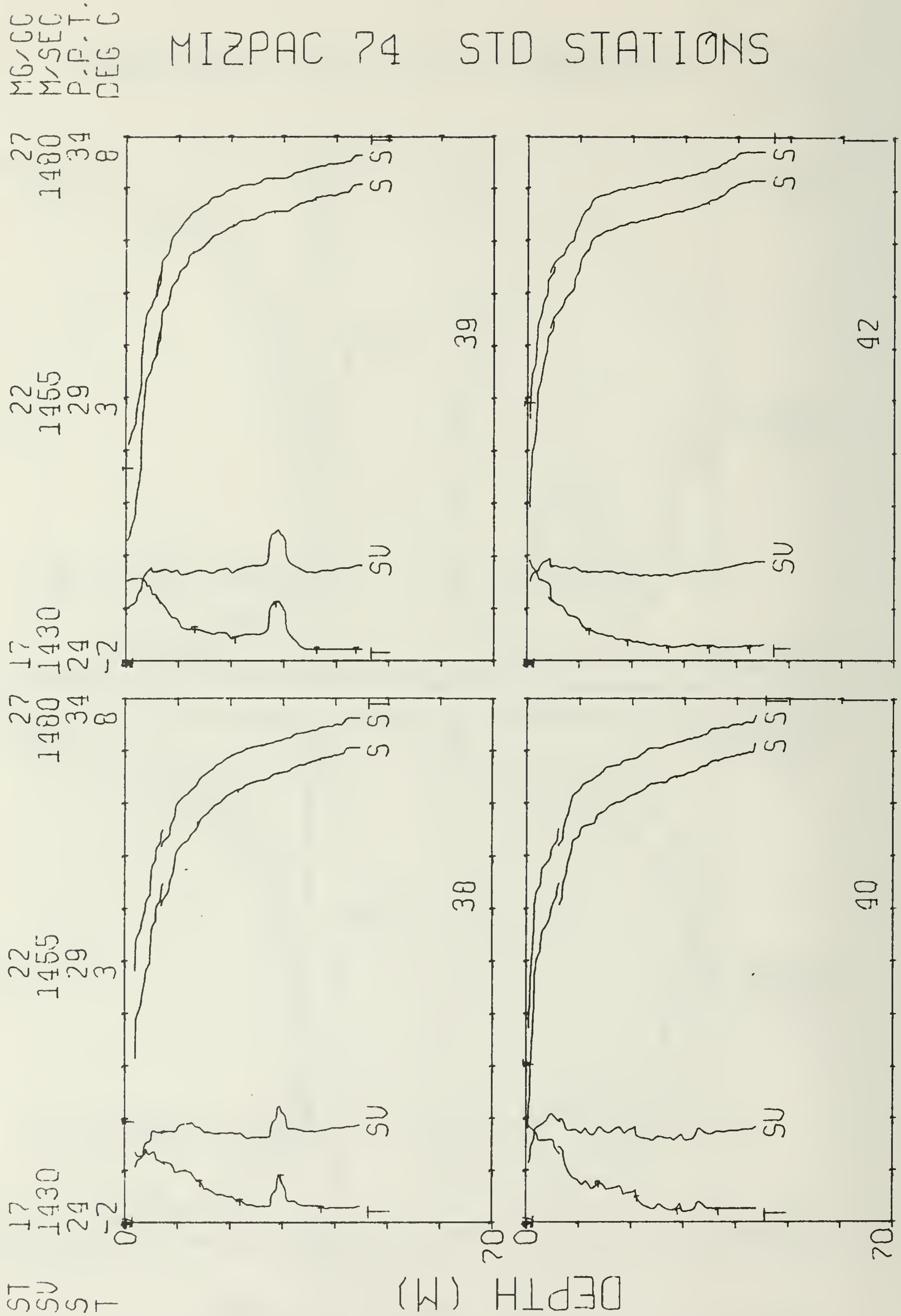
ST MG/CC
SU M/SEC
S P.P.T.
T DEG C
17 1430 24 -2
22 1455 29 3
27 1480 34 8
DEPTH (M)
0
70
34
35
36
37
S ST
S
SU
T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MG/CC
M/SEC
P.P.T.
DEG C
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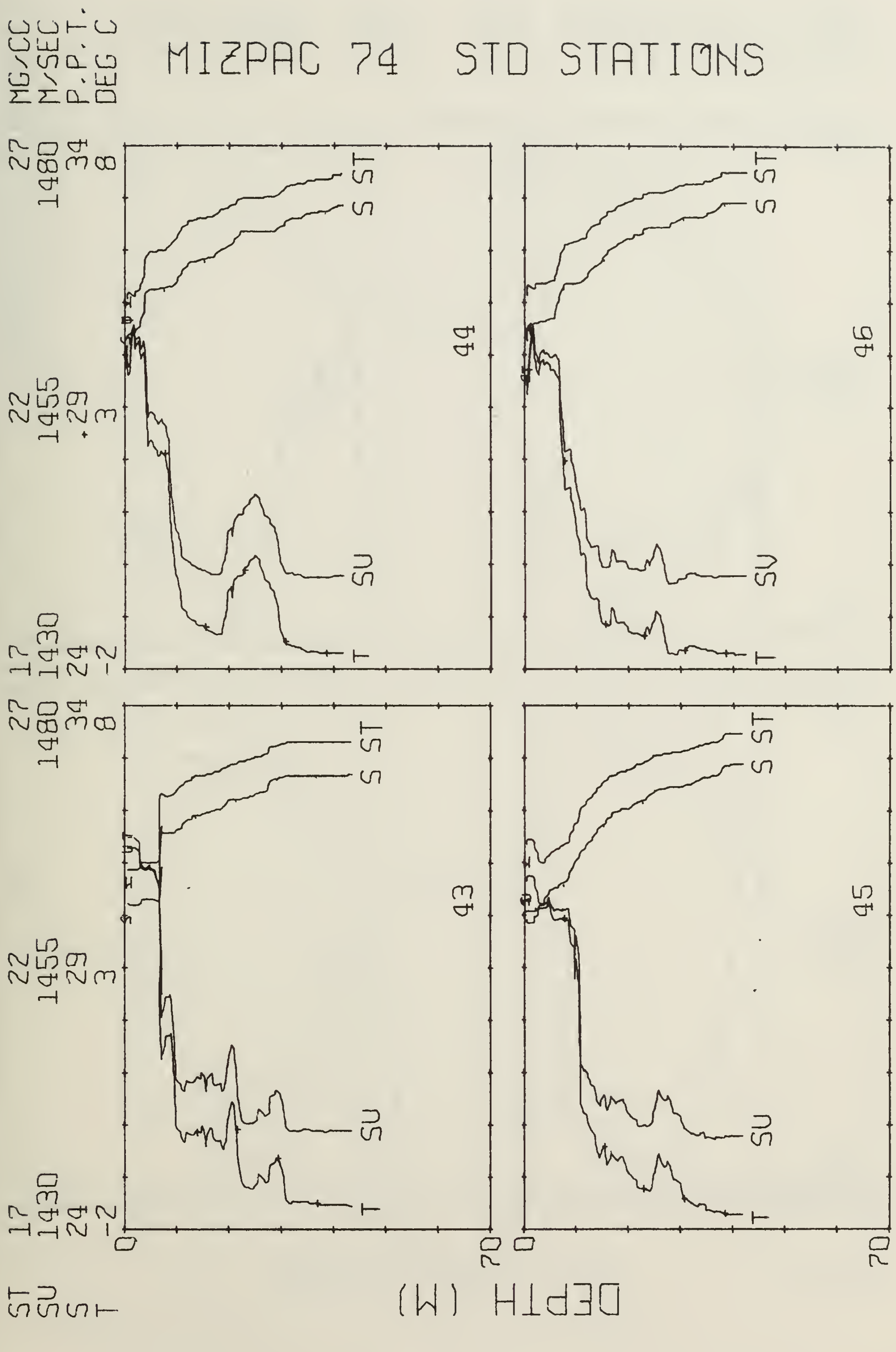
22 1455 29 3
17 1430 24 -2
ST
SV
S
T
39
42
38
40
SV
T
S
ST
0
70
DEPTH (M)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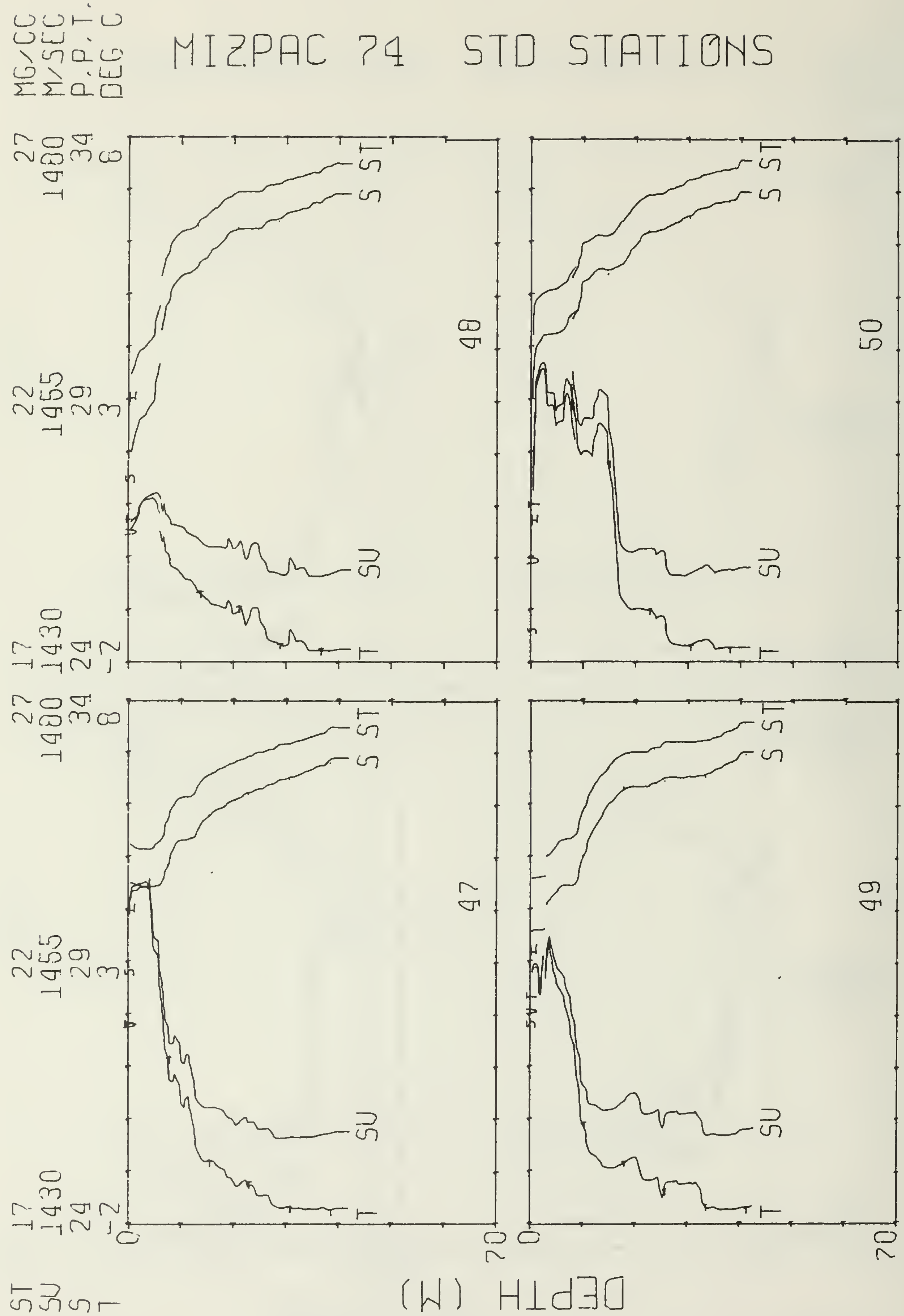
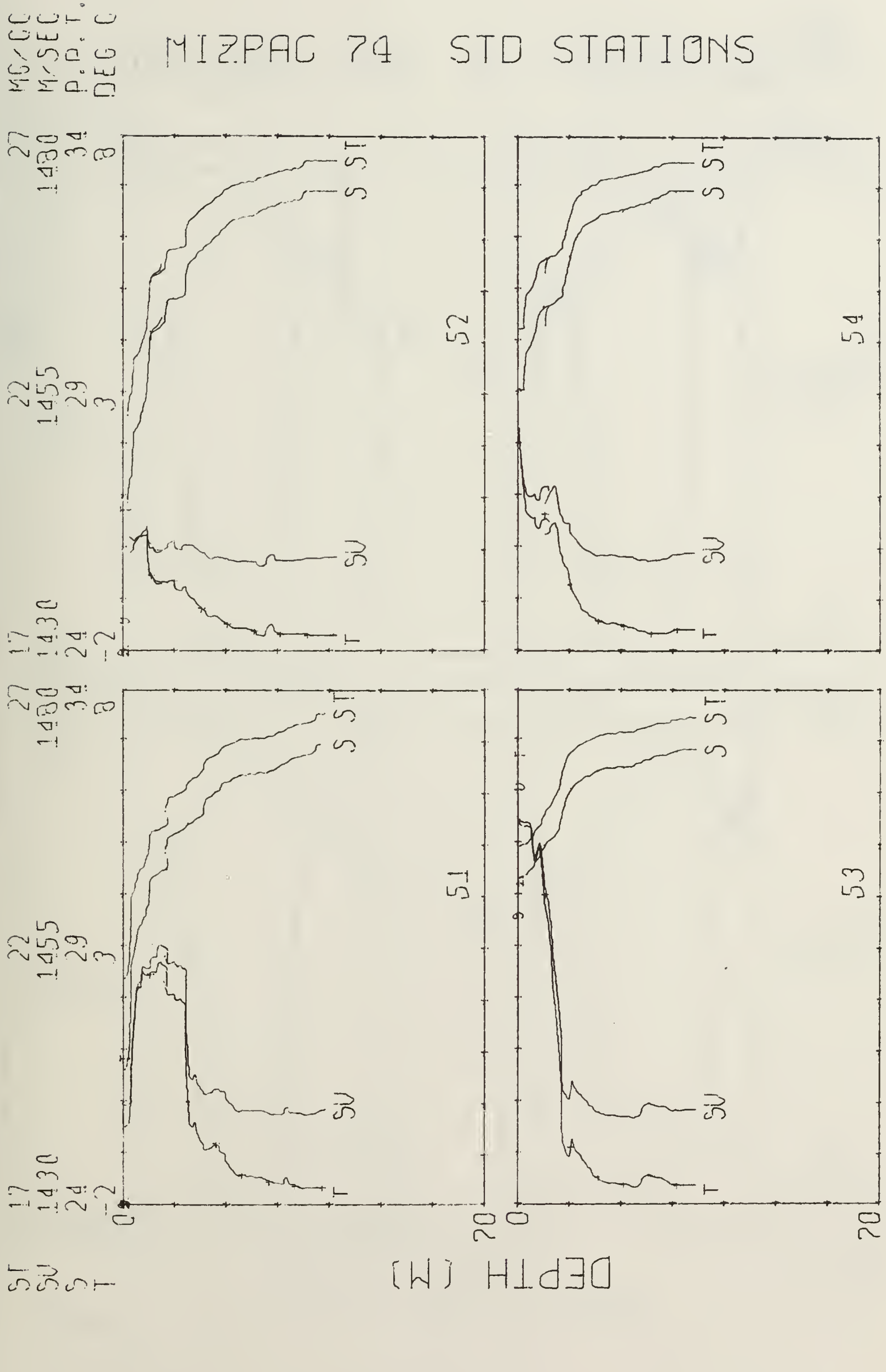
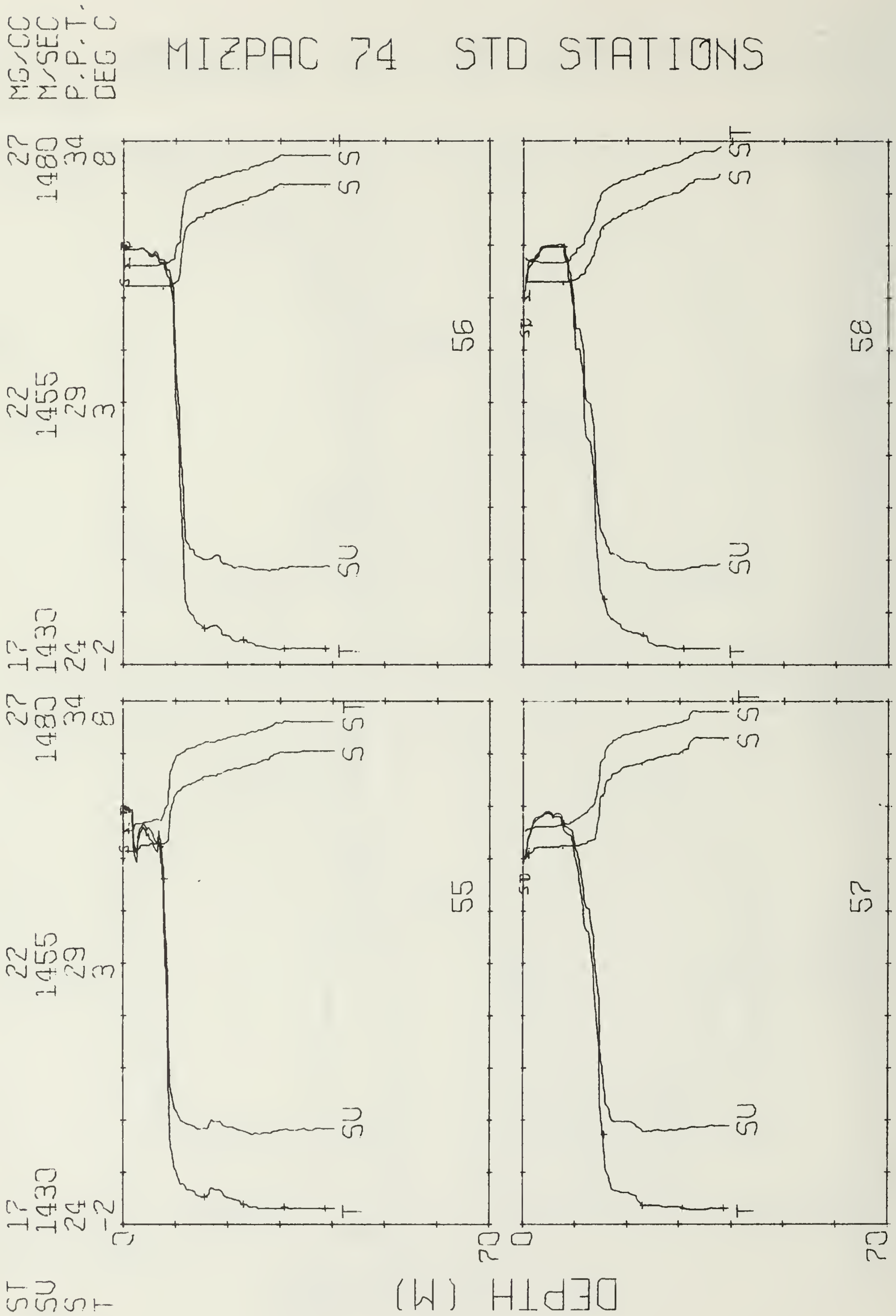
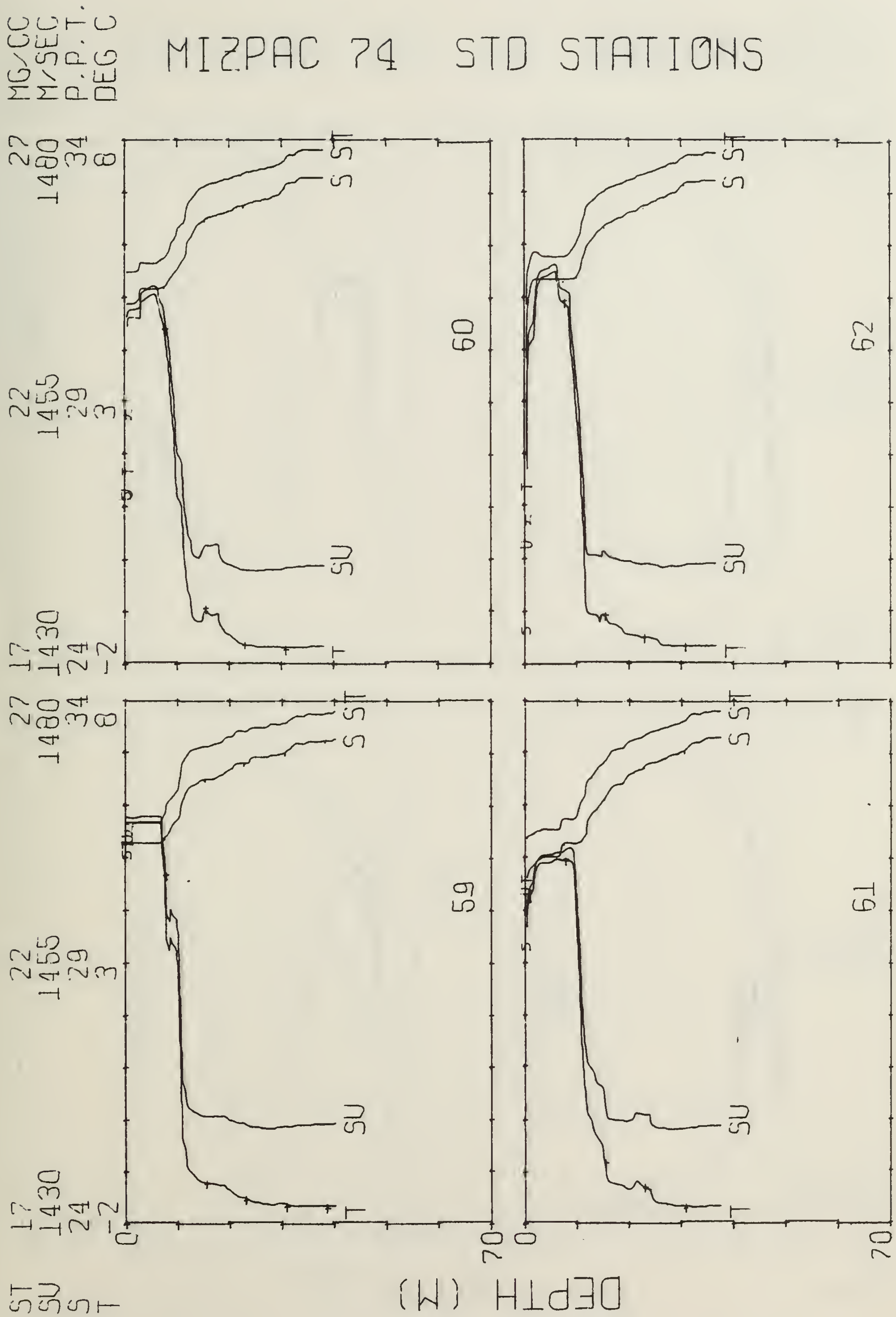
ST SU S T
MG/CC M/SEC P.P.T. DEG C
17 1430 24 -2
22 1455 29 3
27 1480 34 8
DEPTH (M)
0
70
43
44
45
46
S ST
S
SU
T



MIZPAC 74 STD STATIONS
MG/CC
M/SEC
P.P.T.
DEG C
ST
SU
S
T
DEPTH (M)
47
48
49
50


MIZPAC 74 STD STATIONS
MG/CC
M/SEC
P.P.T.
DEG C
ST
SV
S
T
DEPTH (M)
51
52
53
54
0
20
70
17 1430 24 -2
22 1455 29 3
27 1480 34 8
S ST
SV
T


MIZPAC 74 STD STATIONS
MG/CC
M/SEC
P.P.T.
DEG C
ST
SU
S
T
DEPTH (M)
55
56
57
58
27
1480
34
8
22
1455
29
3
17
1430
24
-2
0
70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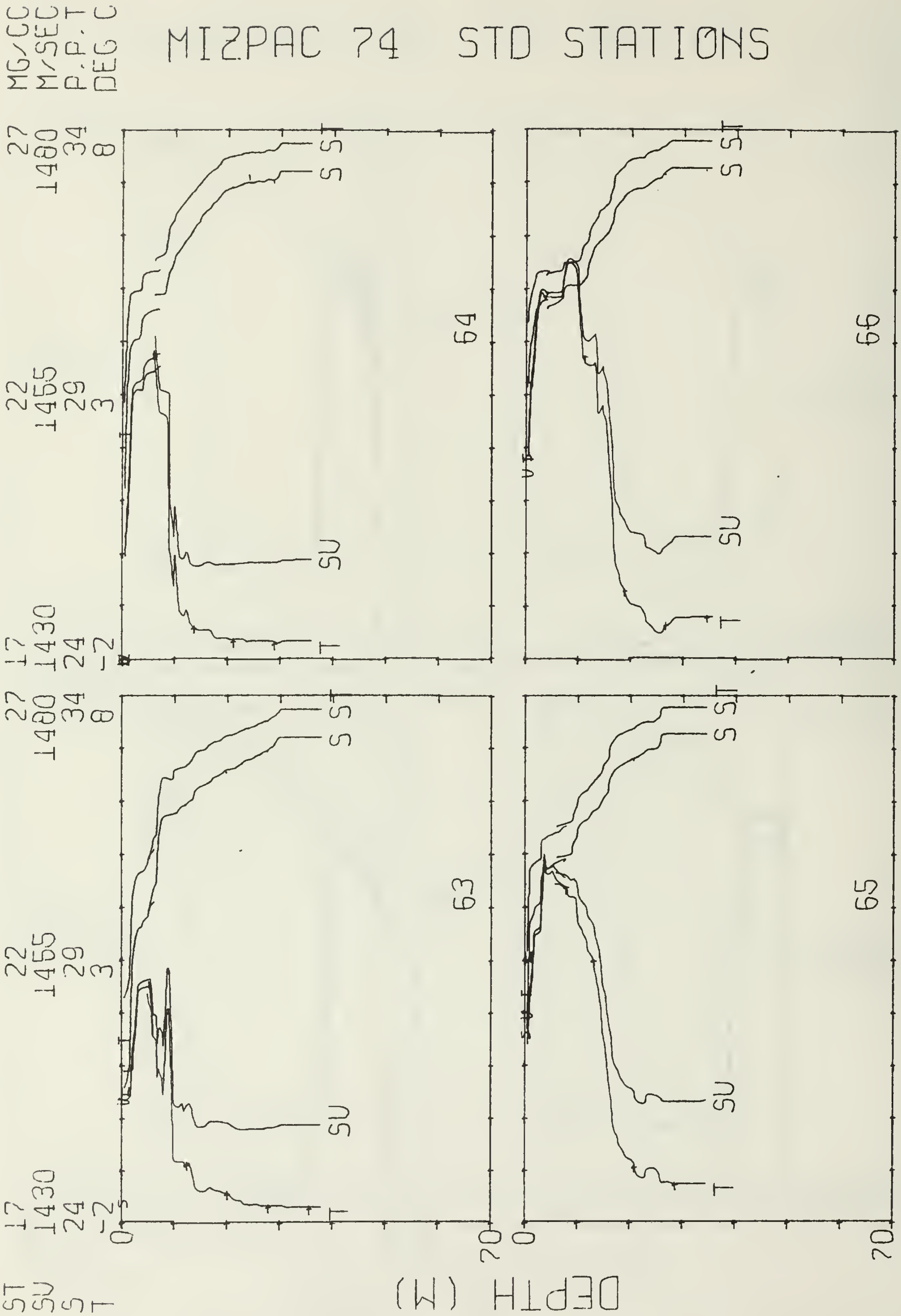
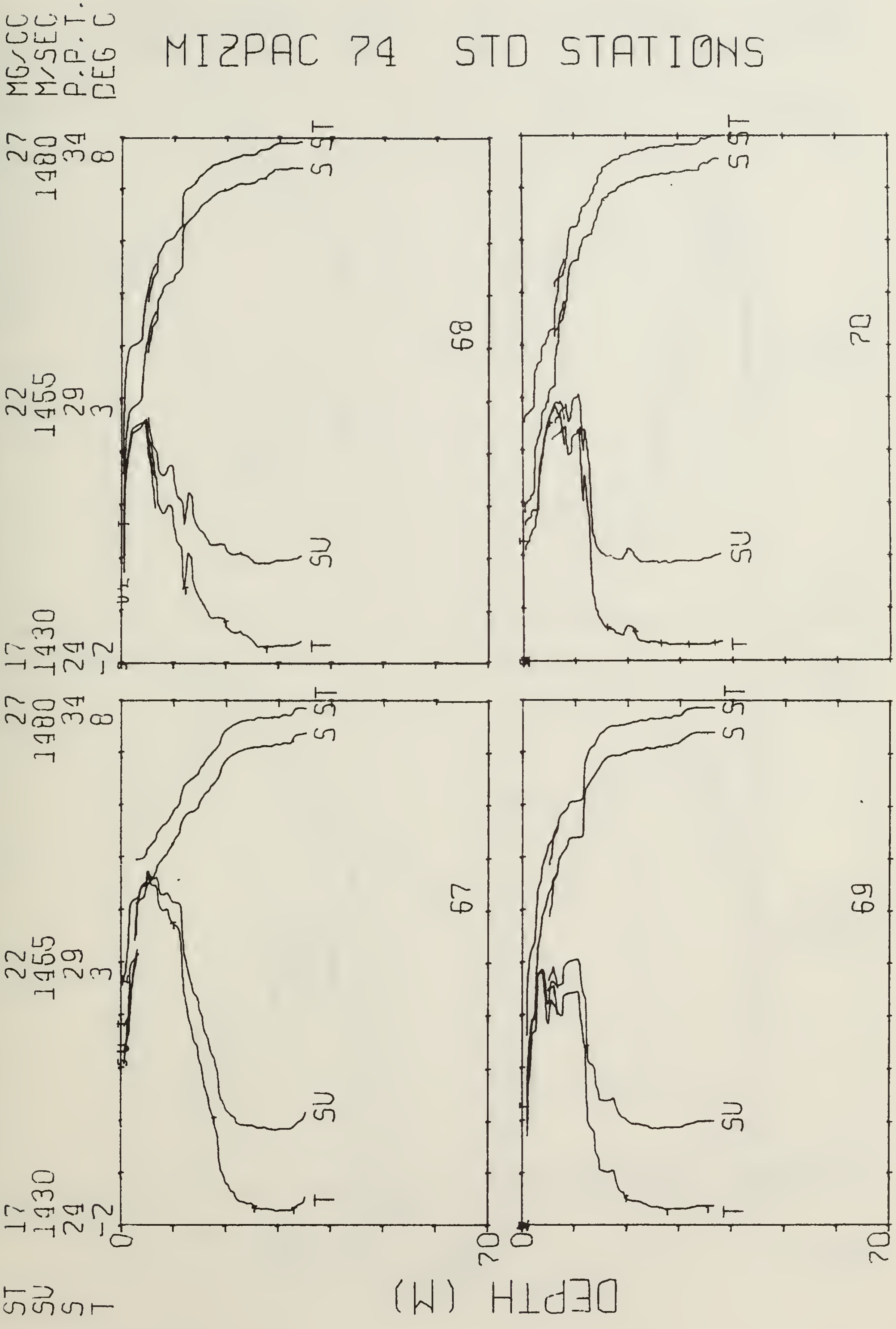
MG/CC
M/SEC
P.P.T.
DEG C
ST
SU
S
T
17 1430 24 -2
22 1455 29 3
27 1480 34 8
0
70
DEPTH (M)
59
60
61
62
SU
ST
S
T


MIZPAC 74 STD STATIONS
MG/CC
M/SEC
P.P.T.
DEG C
63
64
65
66
DEPTH (M)
ST
SV
S
T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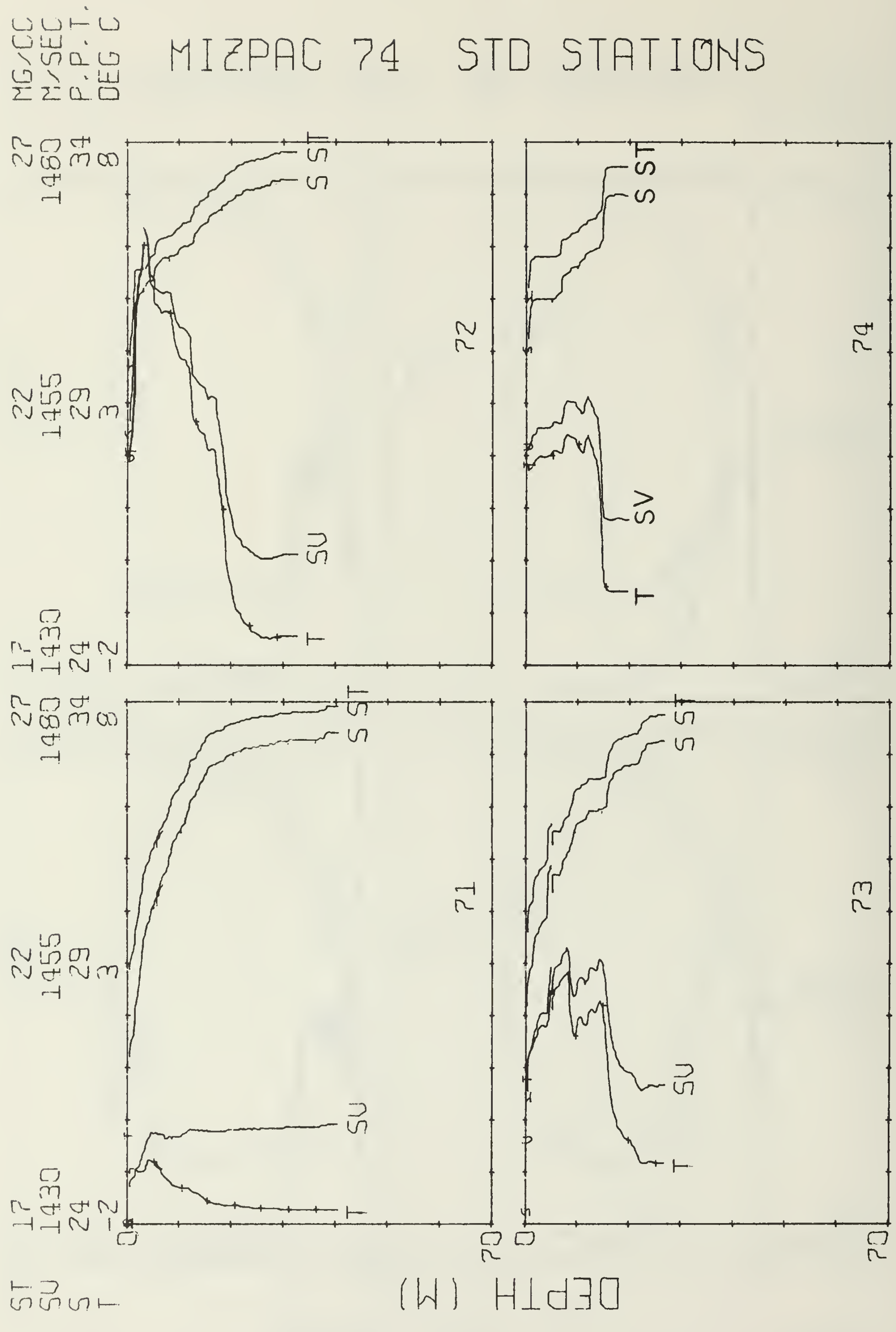
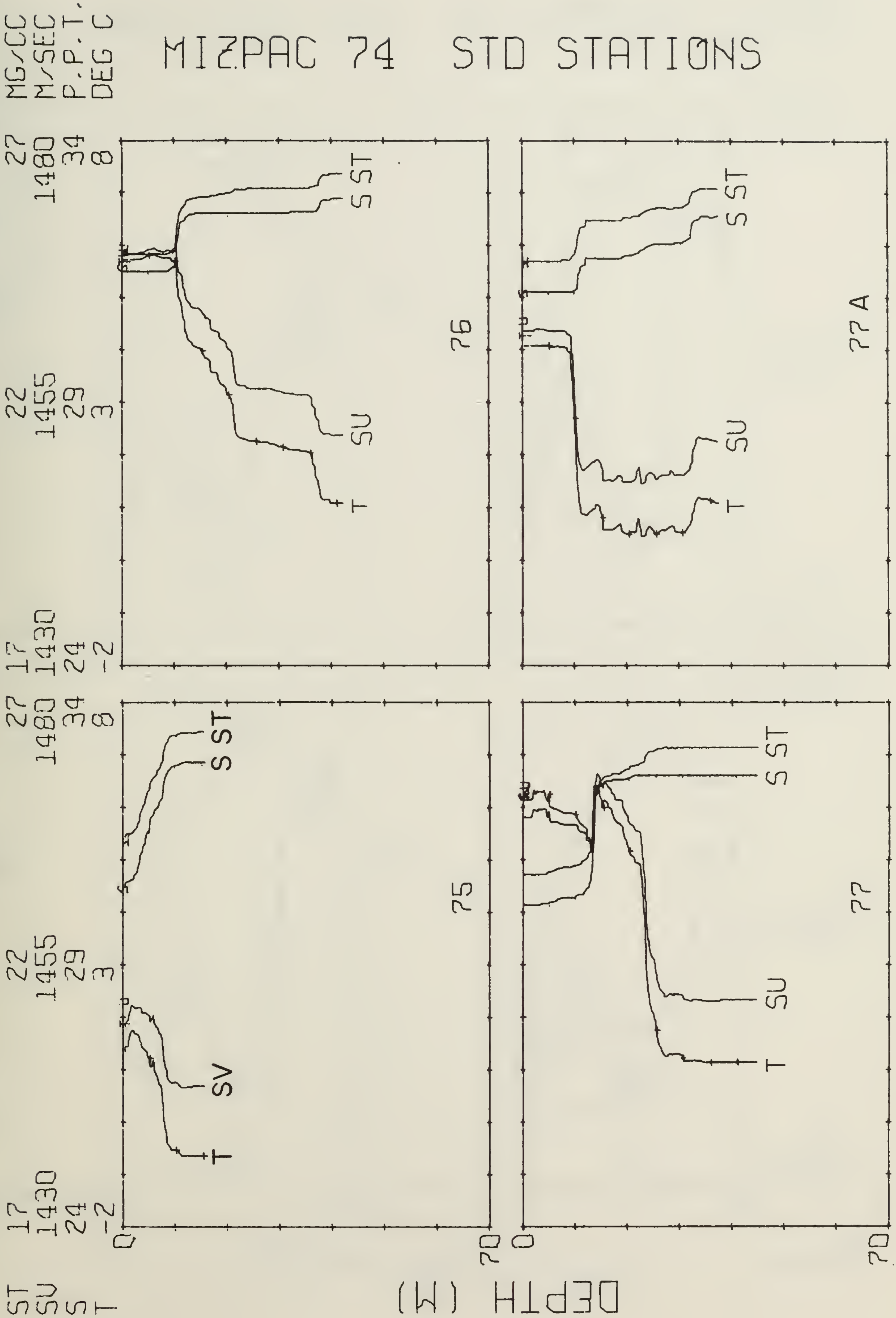
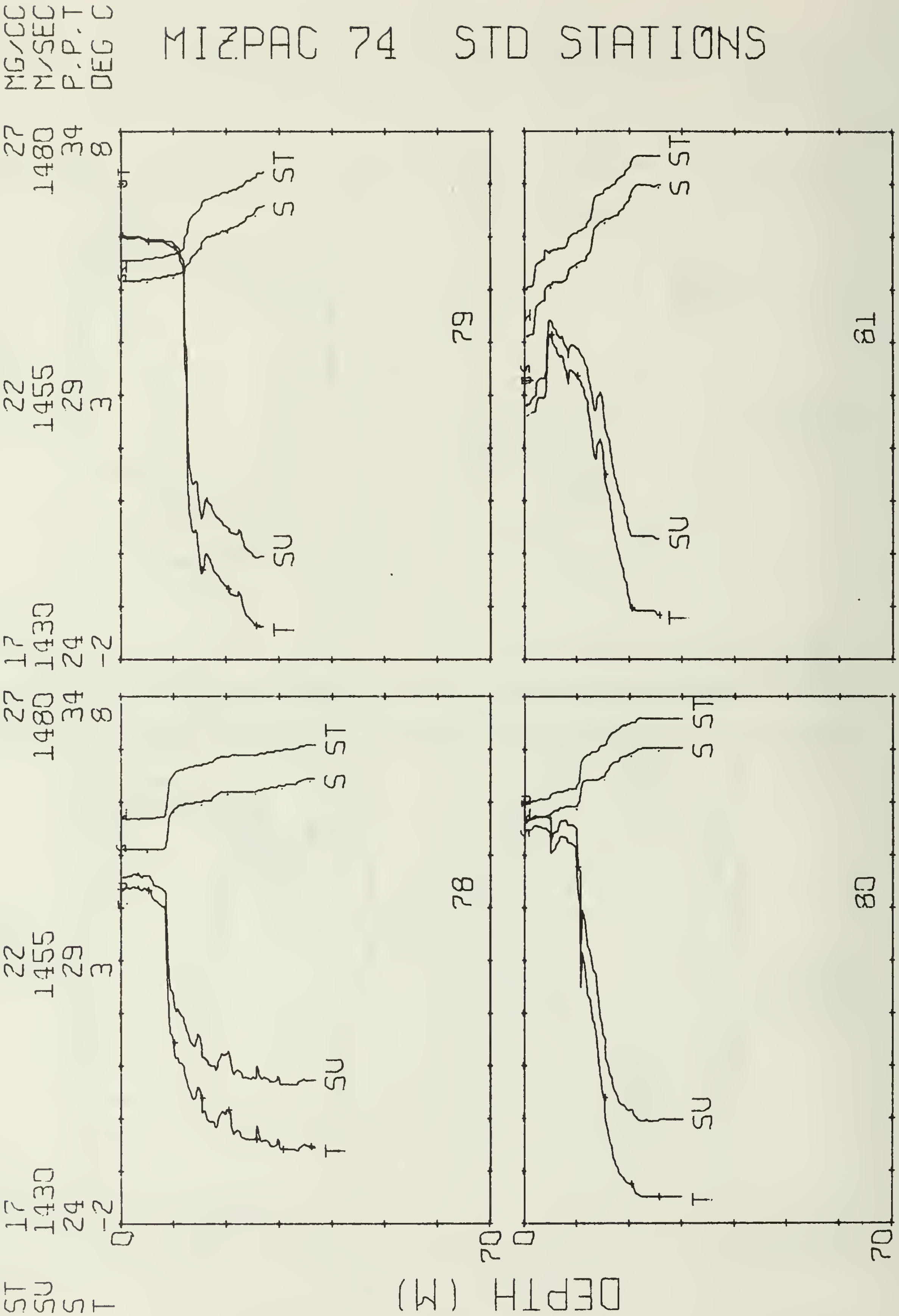
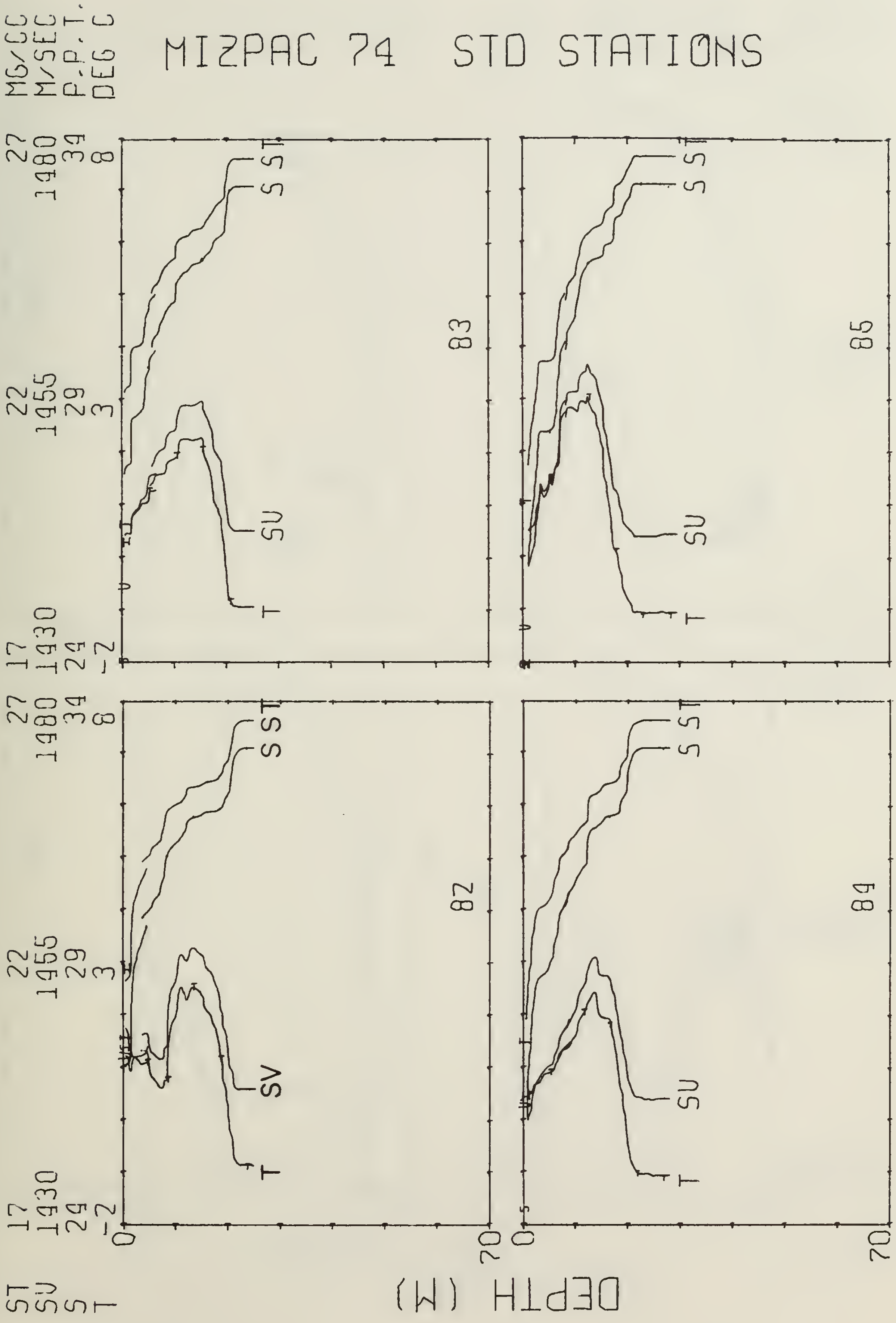
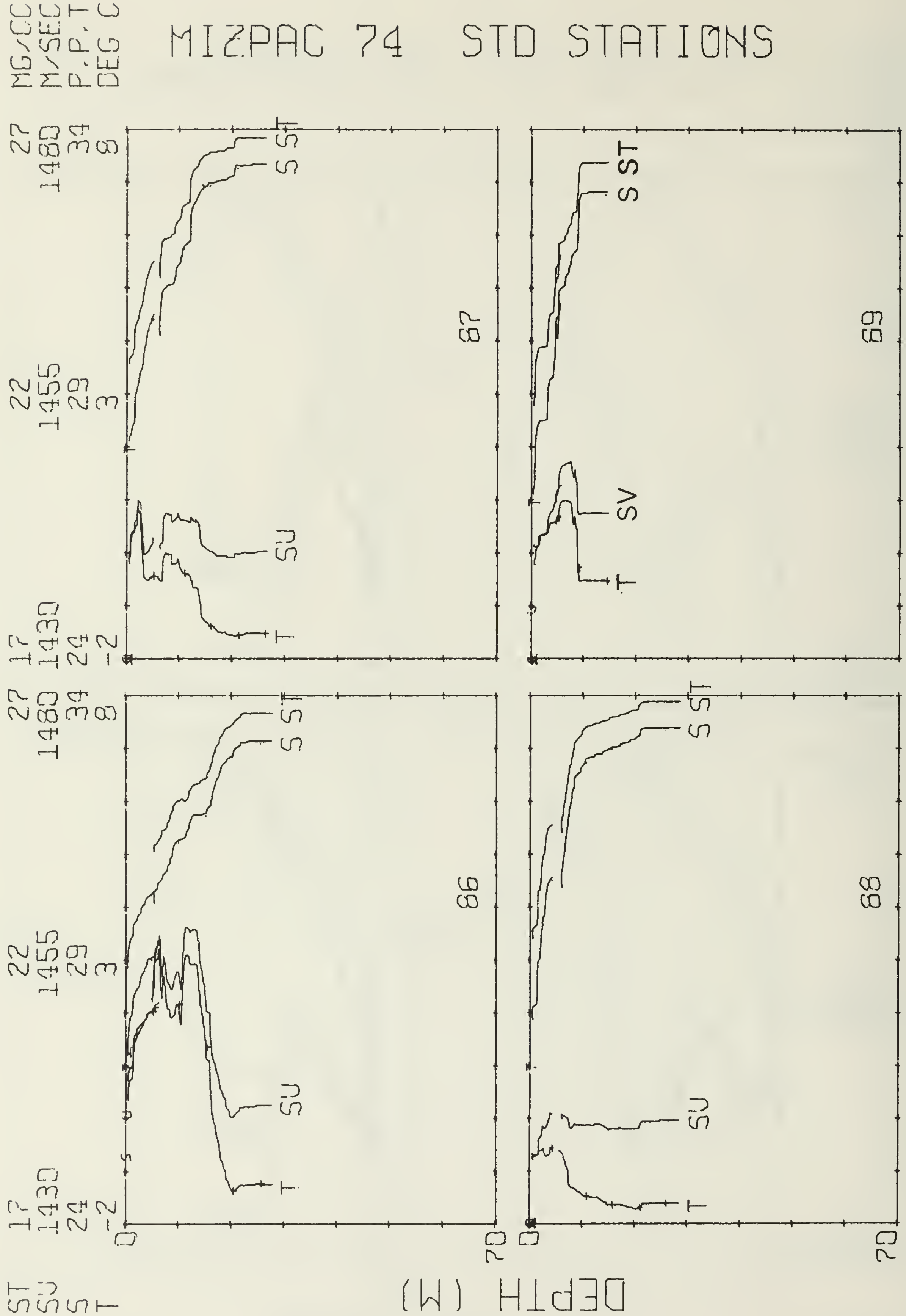
MG/CC
M/SEC
P.P.T.
DEG C
ST
SU
S
T
27
1480
34
8
22
1455
29
3
17
1430
24
-2
0
70
DEPTH (M)
68
70
67
69
S ST
SU
T

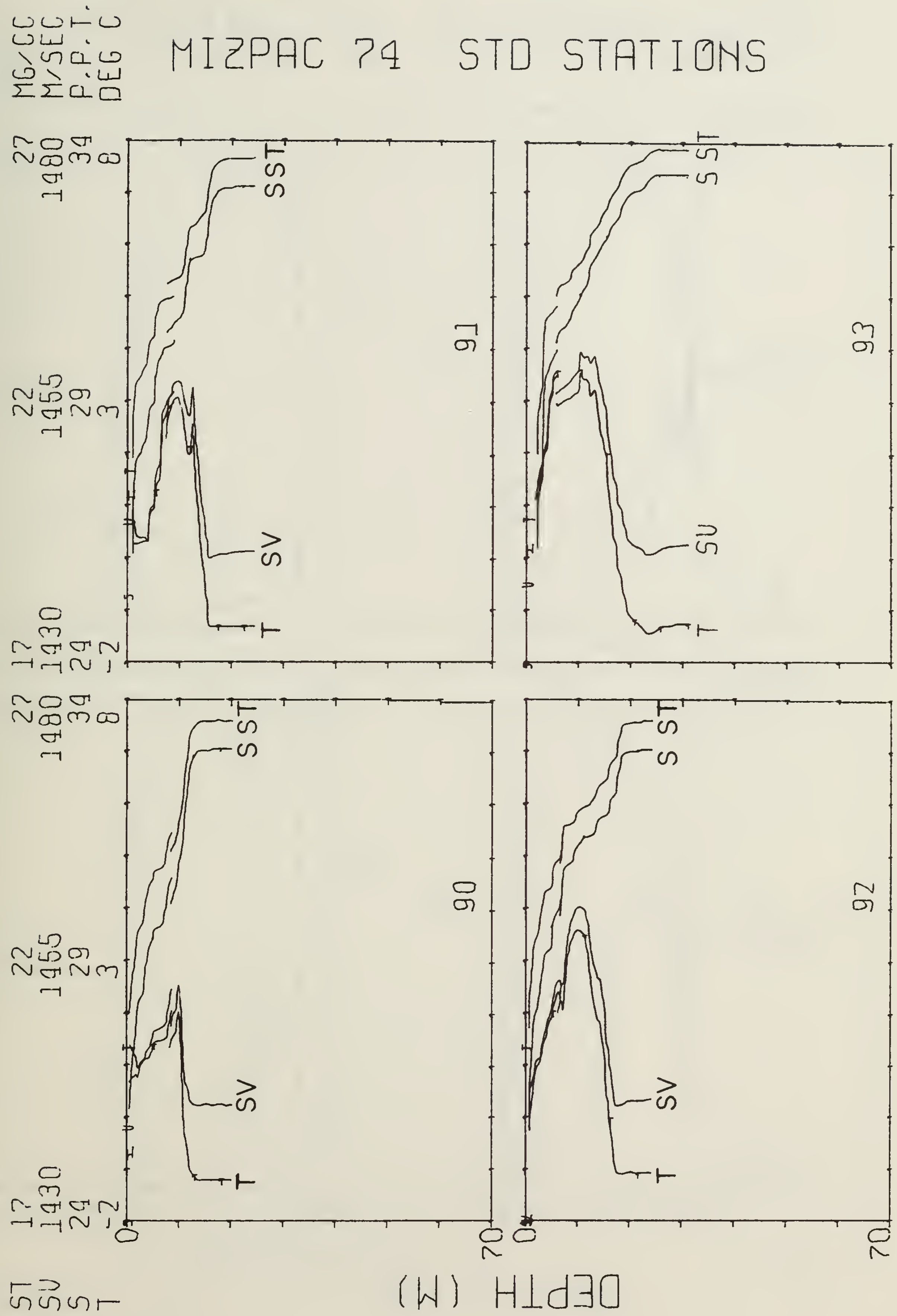

MIZPAC 74 STD STATIONS
MG/CC
M/SEC
P.P.T.
DEG C
27 1480 34 8
22 1455 29 3
17 1430 24 -2
ST
SV
S
T
DEPTH (M)
0
70
71
72
73
74
S ST
SV
T

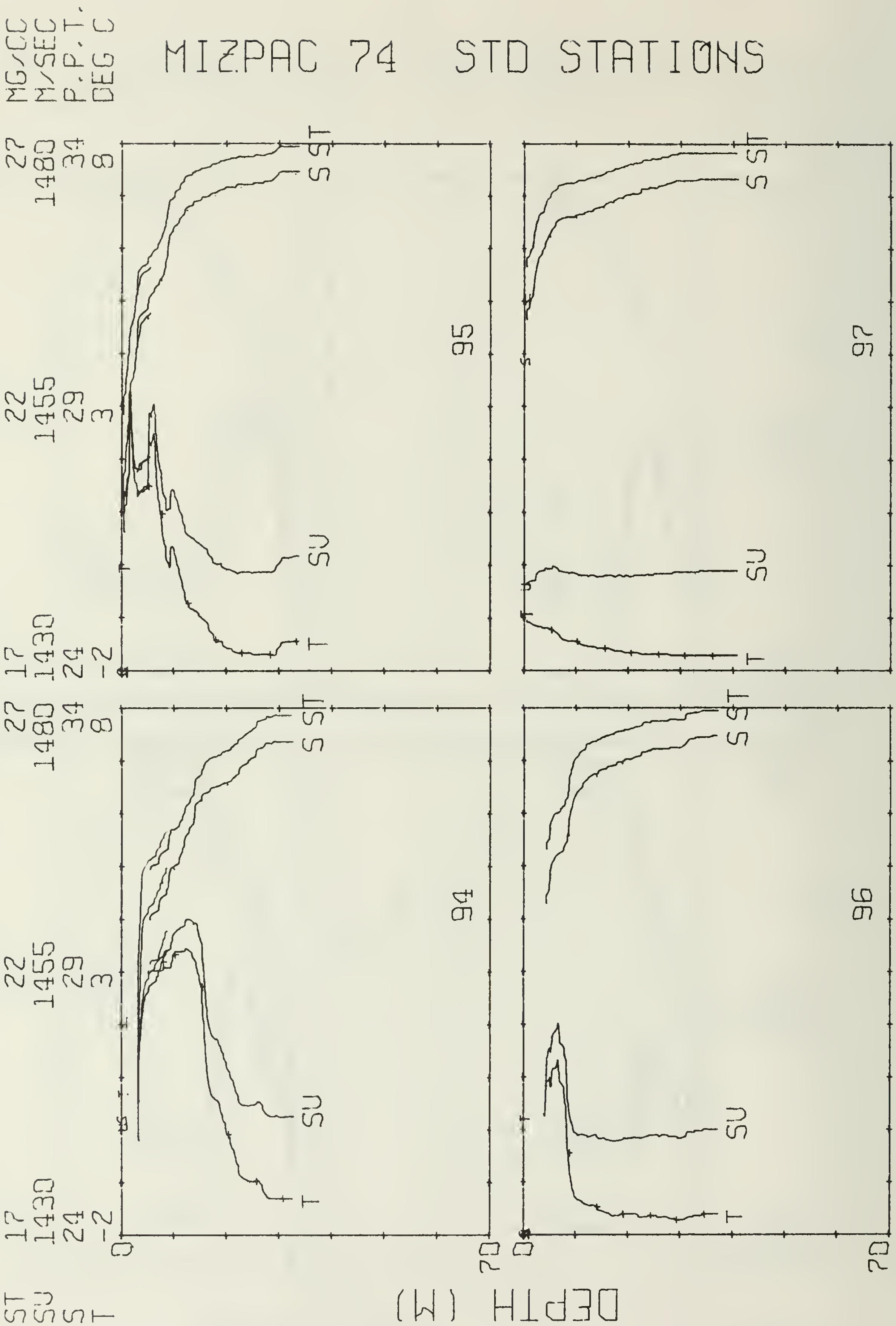

MIZPAC 74 STD STATIONS
ST MG/CC
SV M/SEC
S P.P.T.
T DEG C
DEPTH (M)
75
76
77
77A

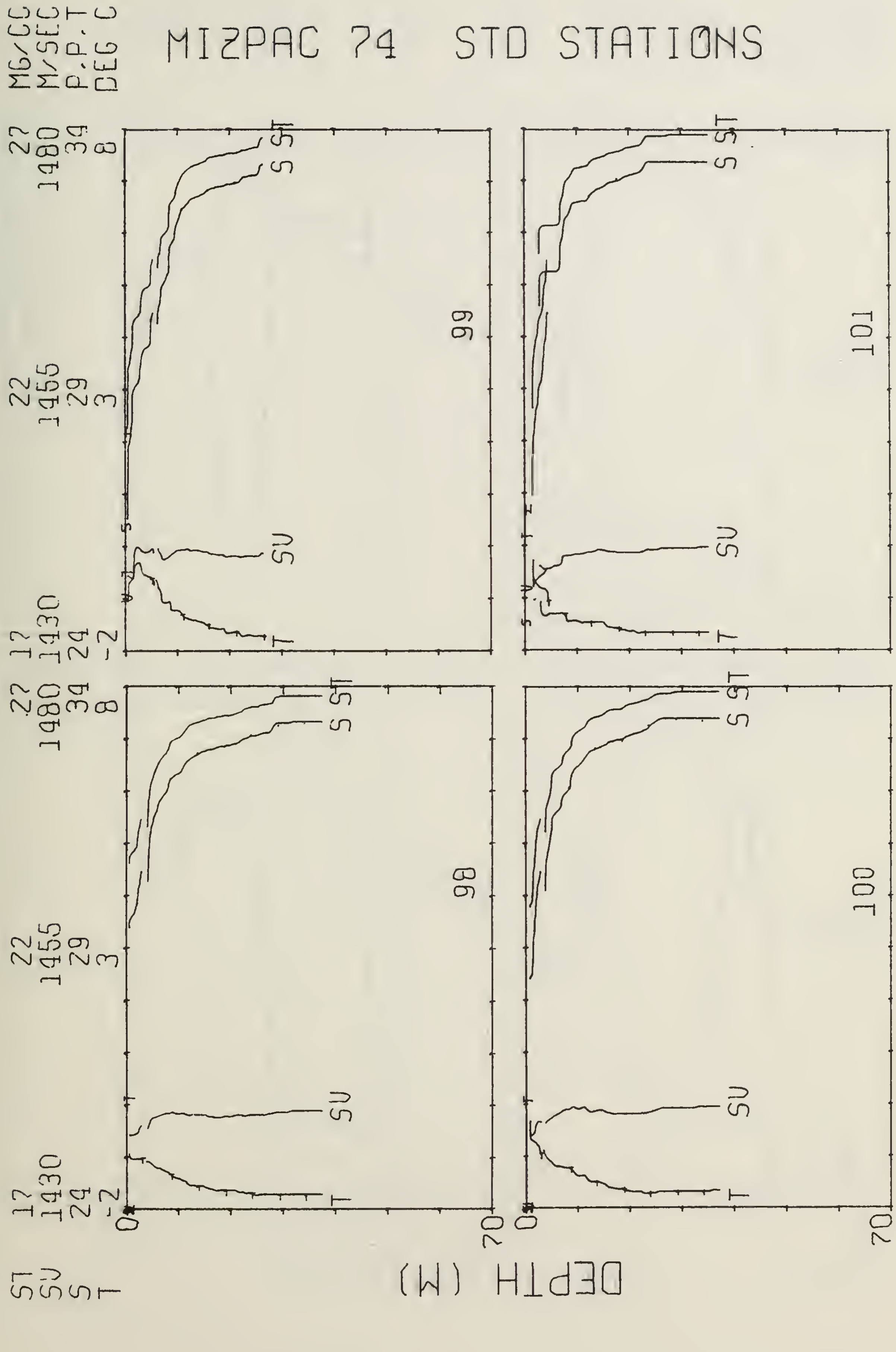

MIZPAC 74 STD STATIONS
ST SU S T
27 1480 34 8
22 1455 29 3
17 1430 24 -2
MG/CC M/SEC P.P.T. DEG C
DEPTH (M)
0
70
78
79
80
81
S ST
S
SU
T

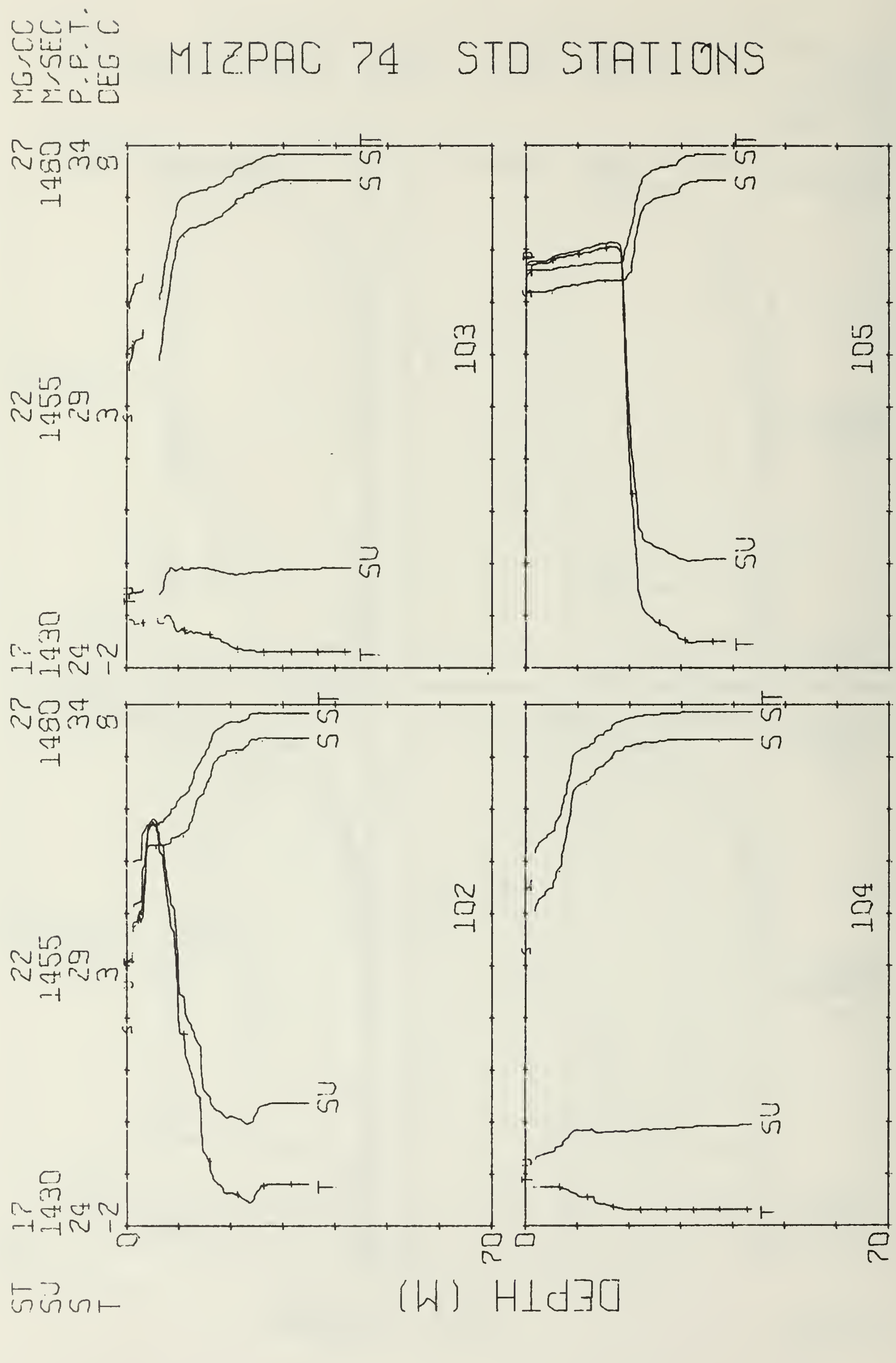

MIZPAC 74 STD STATIONS
MG/CC
M/SEC
P.P.T.
DEG C
ST
SV
S
T
DEPTH (M)
83
85
82
84
SST
SV
T
17
1930
29
-2
22
1955
29
3
27
1980
39
8
0
70

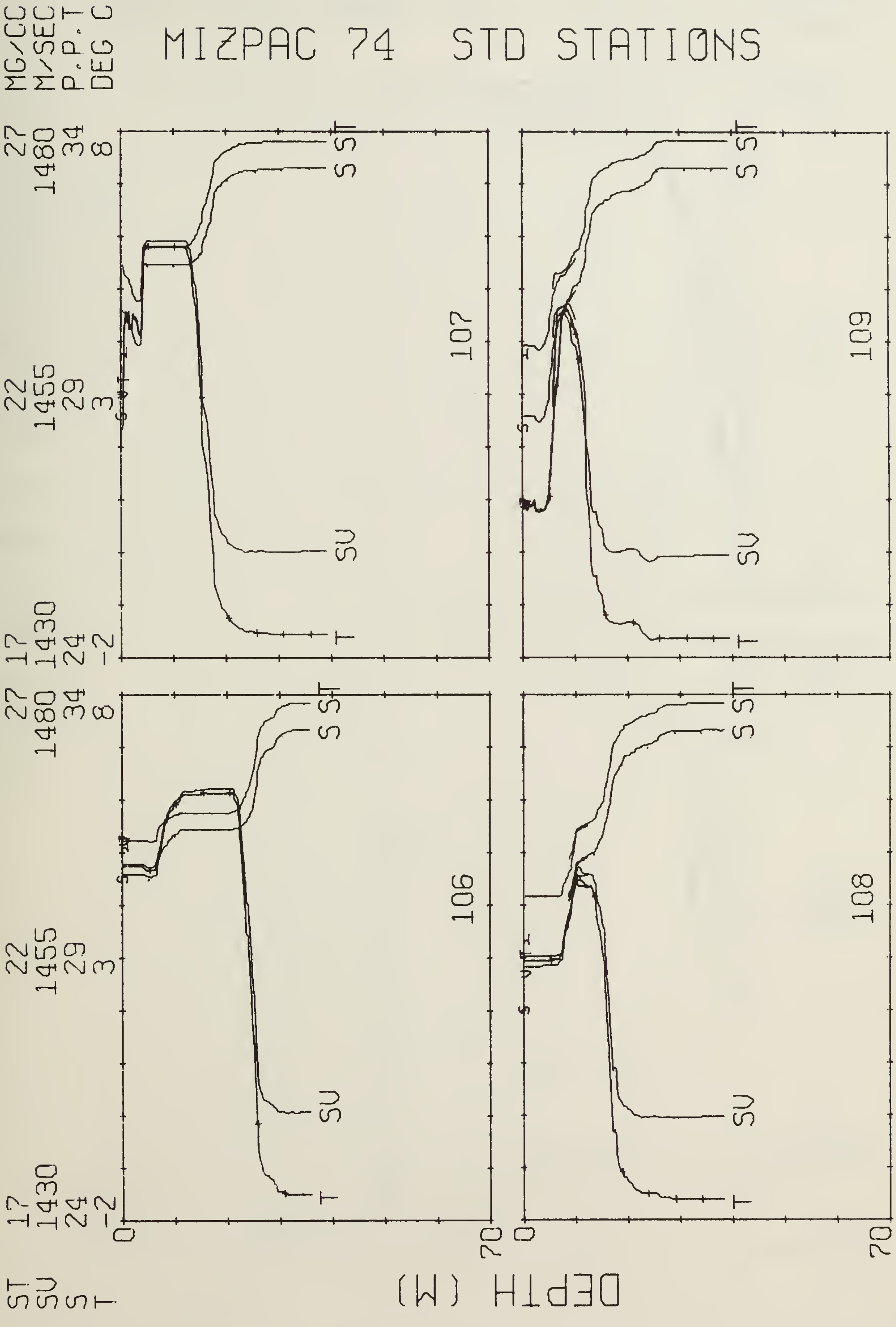

MIZPAC 74 STD STATIONS
ST SV S T
MG/CC M/SEC P.P.T. DEG C
17 1430 24 -2
22 1455 29 3
27 1480 34 8
DEPTH (M)
0
70
86
87
88
89
S ST
SV
T

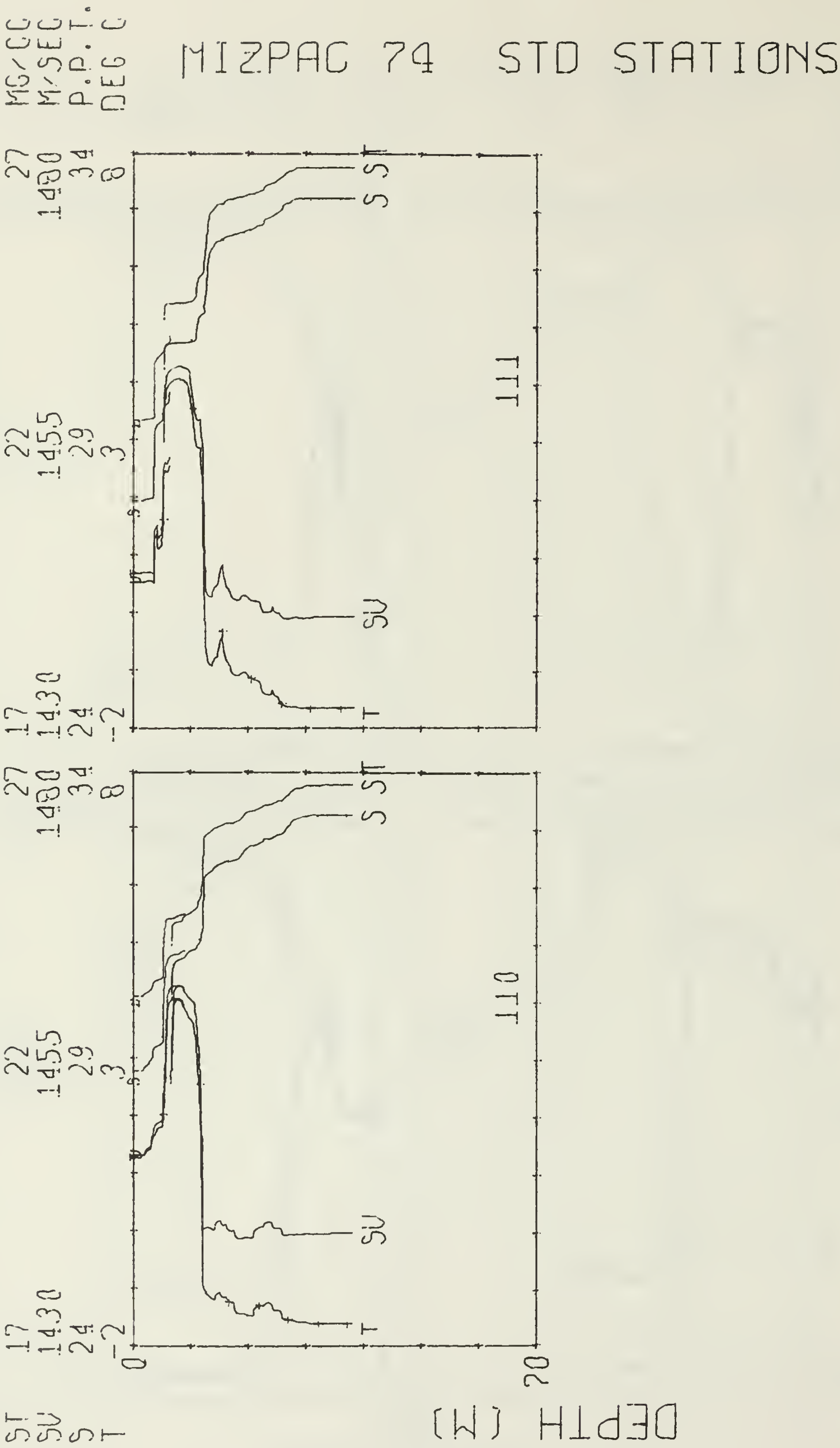

MIZPAC 74 STD STATIONS
ST MG/CC
SV M/SEC
S P.P.T.
T DEG C
91
93
90
92
SST
S
SV
T
DEPTH (M)
0
70


MIZPAC 74 STD STATIONS
ST MG/CC
SV M/SEC
S P.P.T.
T DEG C
17 22 27
1430 1455 1480
24 29 34
-2 3 8
0 70
DEPTH (M)
94
95
96
97
S ST
SV
T


MIZPAC 74 STD STATIONS
ST MG/CC
SV M/SEC
S P.P.T.
T DEG C
17 1430 24 -2
22 1455 29 3
27 1480 34 8
DEPTH (M)
0
70
98
99
100
101
S ST
SV
T


MIZPAC 74 STD STATIONS
ST MG/CC
SU M/SEC
S P.P.T.
T DEG C
DEPTH (M)
102
103
104
105


MIZPAC 74 STD STATIONS
ST SU S T
MG/CC M/SEC P.P.T. DEG C
DEPTH (M)
106
107
108
109


MIZPAC 74 STD STATIONS
ST SV S T
17 1430 24 -2
22 1455 29 3
27 1480 34 8
MG/CC M/SEC P.P.T. DEG C
110
111
T SV S ST
0
20
DEPTH (M)

APPENDIX III

XBT HEADING DATA AND TEMPERATURE PROFILES

MIZPAC 74 X8T STATIONS

NAT	SHIP	LAT	LONG	MSQ	MO	DY	YR	HR	STA	DPTH	08S	COD	IC	WVD	HT	PER	WND	V	8AR	DRY	WET	WTHR	CL	AMT	VIS	SORD
31	8I	69-16.0	170-00.6	233	07	18	74	12.9	033A	53	142	3	7	99	X	X	99									A
31	8I	69-13.4	170-00.2	233	07	.18	74	13.3	0338	55	146	3	5	99	X	X	99									8
31	BI	69-12.1	169-59.9	233	07	18	74	13.5	033C	55	145	3	6	99	X	X	99									C
31	BI	69-10.5	169-59.7	233	07	18	74	13.6	033D	54	142	3	4	99	X	X	99									D
31	BI	69-09.5	169-59.6	233	07	18	74	13.8	033E	55	144	3	3	99	X	X	99									E
31	8I	69-08.7	169-59.1	233	07	18	74	14.0	033F	53	140	3	2	99	X	X	99									F
31	8I	69-07.3	169-59.0	233	07	18	74	14.2	033G	54	144	3	1	99	X	X	99									G
31	8I	69-05.9	169-58.8	233	07	18	74	14.4	033H	55	145	3	0	99	X	X	99									H
31	8I	69-33.6	168-53.0	233	07	19	74	06.4	042A	53	139	3	0	99	X	X	99									A
31	BI	69-32.0	168-53.1	233	07	19	74	06.6	0428	52	138	3	0	99	X	X	99									B
31	BI	69-29.3	168-53.3	233	07	19	74	07.0	042C	52	076	3	0	99	X	X	99									C
31	BI	69-28.0	168-53.5	233	07	19	74	07.2	042D	51	136	3	0	99	X	X	99									D
31	8I	69-26.0	168-53.6	233	07	19	74	07.4	042E	52	136	3	0	99	X	X	99									E
31	8I	69-23.7	168-53.7	233	07	19	74	07.6	042F	52	134	3	0	99	X	X	99									F
31	BI	69-22.2	168-53.8	233	07	19	74	07.8	042G	52	135	3	0	99	X	X	99									G
31	BI	69-20.9	168-53.9	233	07	19	74	08.1	042H	51	183	3	0	99	X	X	99									H
31	8I	69-32.0	167-36.0	233	07	20	74	02.0	052A	47	121	3	2	99	X	X	99									A
31	8I	69-28.8	167-36.1	233	07	20	74	02.4	052C	47	074	3	1	99	X	X	99									C
31	8I	69-28.7	167-36.2	233	07	20	74	02.5	052D	47	124	3	1	99	X	X	99									D
31	8I	69-27.3	167-36.3	233	07	20	74	02.6	052E	48	128	3	1	99	X	X	99									E

MIZPAC 74 XBT STATIONS

NAT	SHIP	LAT	LONG	MSQ	MO	DY	YR	HR	STA	DPTH	OBS	COD	IC	WVD	HT	PER	WND	V	BAR	DRY	WET	WTHR	CL	AMT	VIS	SORD
31	BI	69-25.7	167-36.4	233	07	20	74	02.8	052F	48	127	3	1	99	X	X	99									F
31	BI	69-24.2	167-36.5	233	07	20	74	03.0	052G	48	129	3	-2	99	X	X	99									G
31	BI	69-22.6	167-37.0	233	07	20	74	03.2	052H	50	132	3	-3	99	X	X	99									H
31	BI	69-21.0	167-37.5	233	07	20	74	03.4	052I	50	131	3	-4	99	X	X	99									I
31	BI	69-18.5	167-38.0	233	07	20	74	03.7	052J	50	131	3	0	99	X	X	99									J
31	BI	69-15.0	167-39.0	233	07	20	74	04.0	052K	52	139	3	0	99	X	X	99									K
31	BI	69-12.5	167-39.0	233	07	20	74	04.2	052L	50	134	3	0	99	X	X	99									L
31	BI	69-10.0	167-38.9	233	07	20	74	04.5	052M		099	3	0	99	X	X	99									M
31	BI	70-21.5	165-00.0	269	07	21	74	07.7	064A	45	118	3	0	99	X	X	99									A
31	BI	70-34.1	164-21.0	269	07	21	74	17.3	071A	45	119	3	8	99	X	X	99									A
31	BI	70-32.8	164-21.5	269	07	21	74	17.7	071B	46	120	3	7	99	X	X	99									B
31	BI	70-29.8	164-22.2	269	07	21	74	18.1	071C	43	111	3	6	99	X	X	99									C
31	BI	70-26.7	164-23.0	269	07	21	74	18.5	071D	43	115	3	4	99	X	X	99									D
31	BI	70-23.2	164-23.8	269	07	21	74	18.7	071E	43	115	3	2	99	X	X	99									E
01	BI	70-21.3	164-24.2	269	07	21	74	19.0	071F	43	111	3	-4	99	X	X	99									F
31	BI	70-19.9	164-24.6	269	07	21	74	19.2	071G	42	108	3	-6	99	X	X	99									G
31	BI	70-18.0	164-25.0	269	07	21	74	19.4	071H	42	110	3	-6	99	X	X	99									H
31	BI	70-16.1	164-25.5	269	07	21	74	19.7	071I	41	107	3	-6	99	X	X	99									I
31	BI	68-57.0	166-42.5	233	07	22	74	09.5	075A	43	117	3	0	99	X	X	99									A
31	BI	68-57.0	166-51.5	233	07	22	74	09.7	075B	46	124	3	0	99	X	X	99									B

MIZPAC 74 XBT STATIONS

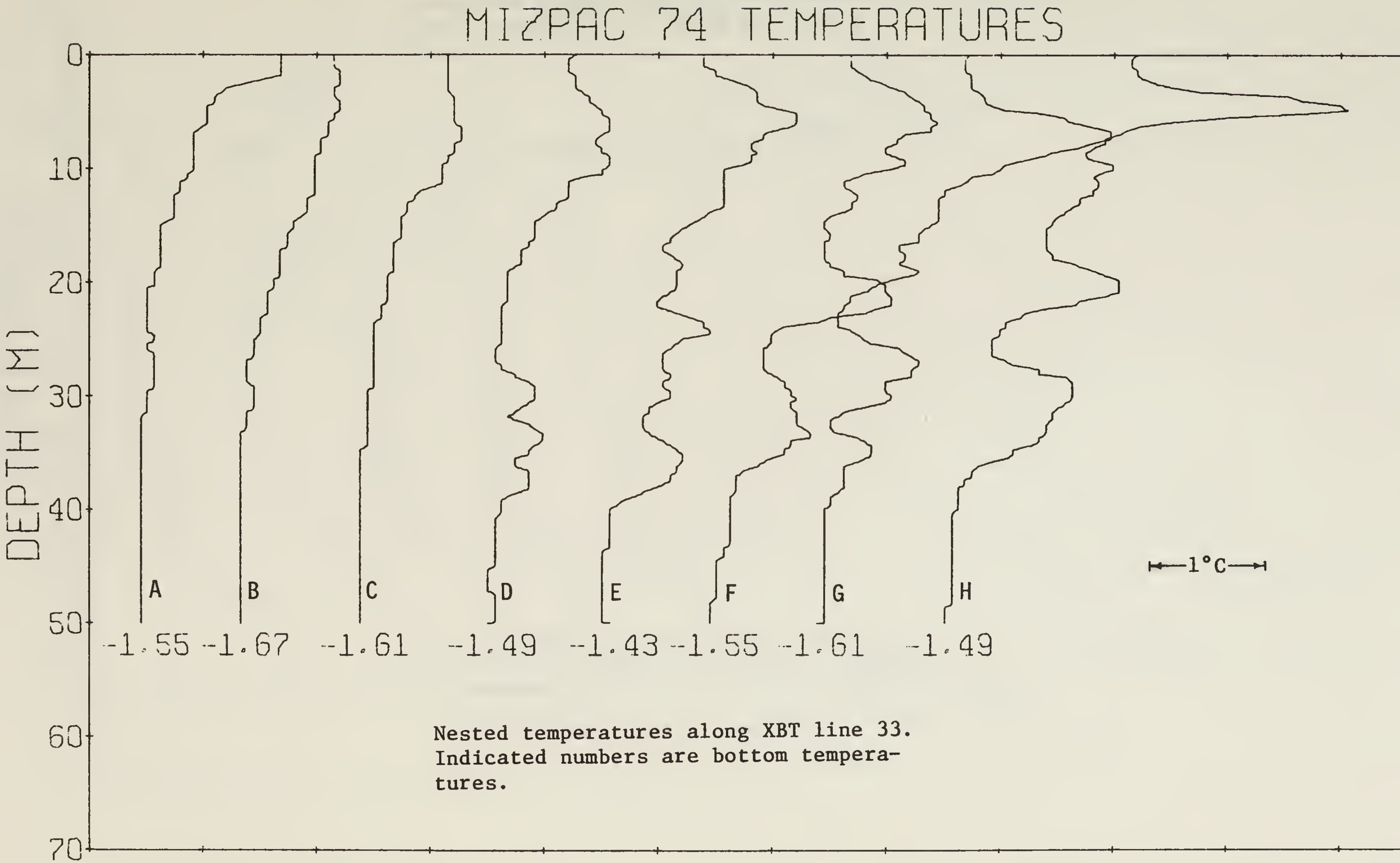
NAT	SHIP	LAT	LONG	MSQ	MO	DY	YR	HR	STA	DPTH	OBS	COD	IC	WVD	HT	PER	WND	V	BAR	DRY	WET	WTHR	CL	AMT	VIS	SORD
31	BI	68-57.0	167-00.5	233	07	22	74	10.0	075C	46	122	3	0	99	X	X	99									C
31	BI	68-57.0	167-09.5	233	07	22	74	10.3	075D	4B	127	3	0	99	X	X	99									D
31	BI	6B-57.0	167-18.5	233	07	22	74	10.5	075E	47	125	3	0	99	X	X	99									E
31	BI	68-57.0	167-27.5	233	07	22	74	10.7	075F	4B	127	3	0	99	X	X	99									F
31	BI	68-57.0	167-35.5	233	07	22	74	11.0	075G	50	130	3	0	99	X	X	99									G
31	BI	67-4B.0	165-57.0	233	07	22	74	20.2	076A	45	120	3	0	99	X	X	99									A
31	BI	70-30.0	163-01.0	269	07	25	74	19.3	101A	35	096	3	0	99	X	X	99									A
31	BI	70-26.0	163-10.0	269	07	25	74	19.7	101B	35	118	3	0	99	X	X	99									B
31	BI	70-21.5	163-19.5	269	07	25	74	20.5	101C	35	090	3	0	99	X	X	99									C
31	BI	70-19.5	163-23.5	269	07	25	74	20.9	101D	34	093	3	0	99	X	X	99									D
31	BI	70-17.4	163-2B.2	269	07	25	74	21.3	101E	33	084	3	0	99	X	X	99									E
31	BI	70-15.B	163-31.8	269	07	25	74	21.9	101F	32	082	3	0	99	X	X	99									F
31	BI	70-11.7	163-39.3	269	07	25	74	22.6	101G	33	0B6	3	0	99	X	X	99									G
31	BI	70-0B.5	163-45.0	269	07	25	74	23.0	101H	33	0B5	3	0	99	X	X	99									H
31	BI	70-05.0	163-51.5	269	07	25	74	23.5	101I	33	0BB	3	0	99	X	X	99									I
31	BI	70-01.0	164-00.0	269	07	26	74	00.2	101J	33	0B7	3	0	99	X	X	99									J
31	BI	70-05.4	164-03.0	269	07	26	74	00.5	101K	34	090	3	0	99	X	X	99									K
31	BI	70-09.6	164-05.0	269	07	26	74	01.0	101L	34	090	3	0	99	X	X	99									L
31	BI	70-14.2	164-03.2	269	07	26	74	01.5	101M	36	097	3	0	99	X	X	99									M
31	BI	70-19.B	164-02.0	269	07	26	74	02.0	101N	37	101	3	0	99	X	X	99									N

MIZPAC 74 XBT STATIONS

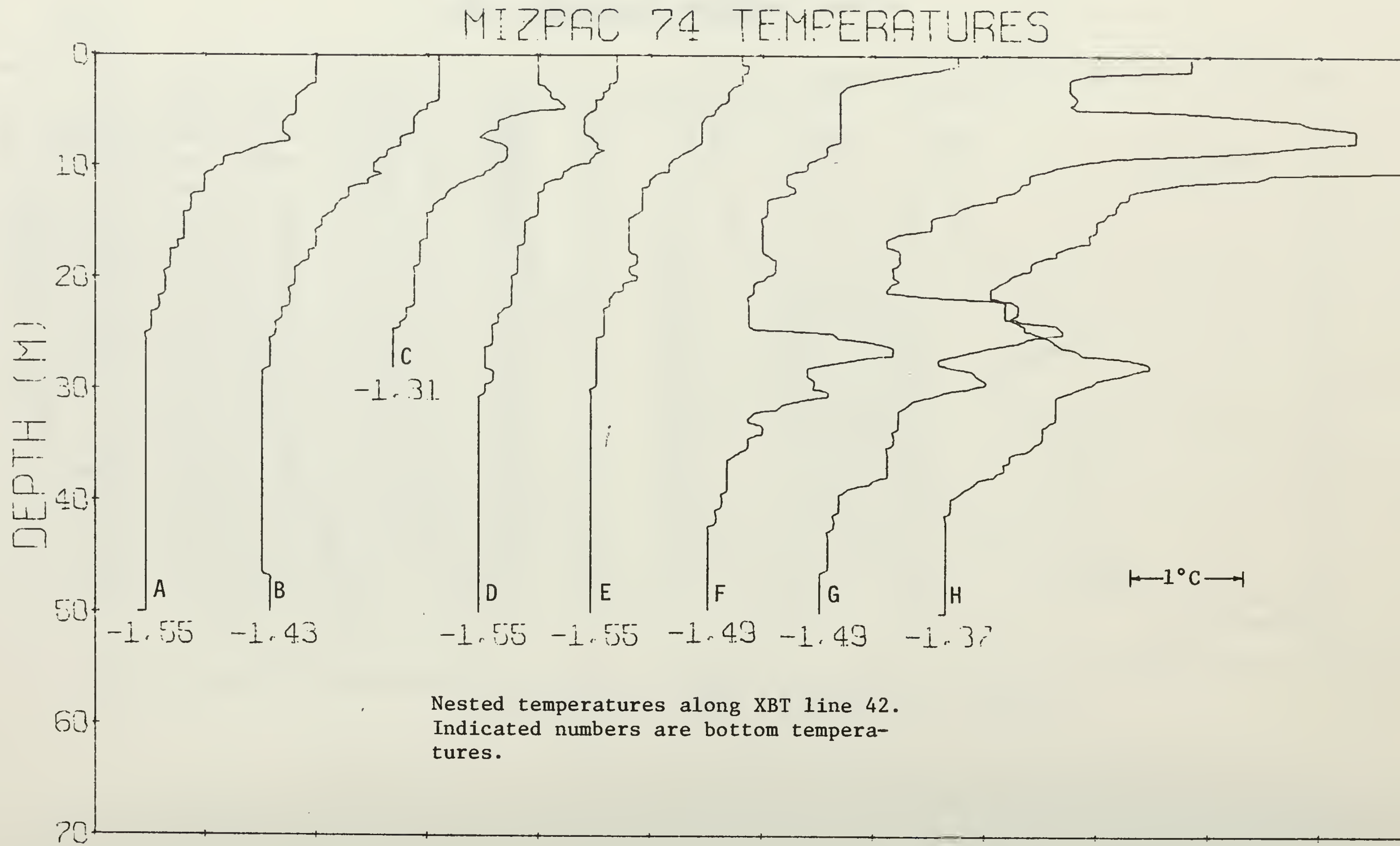
NAT	SHIP	LAT	LONG	MSQ	MO	DY	YR	HR	STA	DPTH	OBS	COD	IC	WVD	HT	PER	WND	V	BAR	DRY	WET	WTHR	CL	AMT	VIS	SORD
31	BI	70-48.5	164-12.0	269	07	26	74	07.4	104A	47	124	3	0	99	X	X	99									A
31	BI	70-50.3	164-30.5	269	07	26	74	08.4	104B	37	100	3	0	99	X	X	99									B
31	BI	70-53.8	164-51.0	269	07	26	74	09.4	104C	39	105	3	0	99	X	X	99									C
31	BI	70-46.5	165-08.0	269	07	26	74	10.4	104D	43	112	3	0	99	X	X	99									D
31	BI	70-38.1	165-24.0	269	07	26	74	11.4	104E	44	117	3	0	99	X	X	99									E
31	BI	70-33.8	165-30.5	269	07	26	74	12.0	104F	43	113	3	0	99	X	X	99									F
31	BI	70-31.8	165-20.5	269	07	26	74	12.5	104G	43	113	3	0	99	X	X	99									G
31	BI	70-30.2	165-10.0	269	07	26	74	13.0	104H	43	113	3	0	99	X	X	99									H
31	BI	70-28.7	165-00.0	269	07	26	74	13.5	104I	45	121	3	0	99	X	X	99									I
31	BI	70-18.5	163-53.0	269	07	28	74	17.8	128A	35	093	3	0	99	X	X	99									A
31	BI	70-21.0	163-38.0	269	07	28	74	18.4	128B	32	081	3	0	99	X	X	99									B
31	BI	70-23.0	163-22.5	269	07	28	74	18.9	128C	32	086	3	0	99	X	X	99									C
31	BI	70-25.0	163-10.0	269	07	28	74	19.3	128D	32	082	3	0	99	X	X	99									D
31	BI	70-27.5	162-53.0	269	07	28	74	19.8	128E	33	088	3	0	99	X	X	99									E
31	BI	70-30.0	162-36.0	269	07	28	74	20.3	128F	33	086	3	0	99	X	X	99									F
31	BI	70-32.0	162-20.5	269	07	28	74	20.8	128G	34	090	3	0	99	X	X	99									G
31	BI	70-34.5	162-07.0	269	07	28	74	21.3	128H	36	098	3	0	99	X	X	99									H
31	BI	70-37.0	161-48.0	269	07	28	74	21.9	128I	37	096	3	0	99	X	X	99									I
31	BI	70-40.0	161-30.5	269	07	28	74	22.4	128J	40	106	3	0	99	X	X	99									J
31	BI	70-41.0	161-19.0	269	07	28	74	22.9	128K	42	112	3	0	99	X	X	99									K

MIZPAC 74 X8T STATIONS

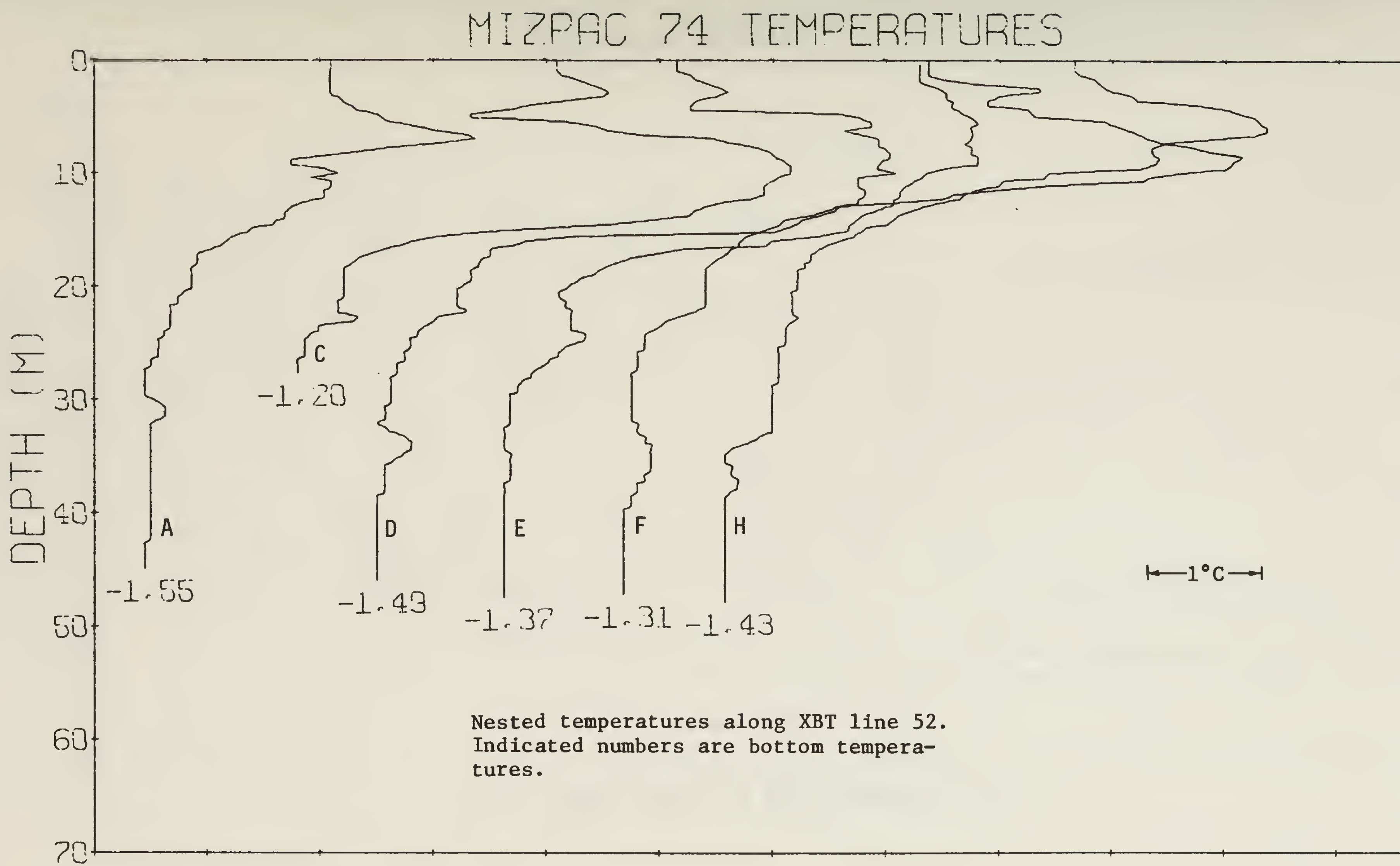
NAT	SHIP	LAT	LONG	MSQ	MO	DY	YR	HR	STA	DPTH	OBS	COD	IC	WVD	HT	PER	WND	V	BAR	DRY	WET	WTHR	CL	AMT	VIS	SORD
31	BI	70-45.0	161-25.5	269	07	28	74	23.4	128L	42	109	3	0	99	X	X	99									L
31	BI	70-47.0	161-26.3	269	07	28	74	23.6	128M	43	113	3	0	99	X	X	99									M
31	8I	70-48.5	161-27.0	269	07	28	74	23.9	128N	47	124	3	0	99	X	X	99									N
31	BI	70-51.0	161-04.0	269	07	29	74	00.7	1280	47	123	3	0	99	X	X	99									O
31	8I	70-51.2	159-47.0	268	07	29	74	07.6	138A	40	106	3	0	99	X	X	99									A
31	8I	70-50.0	159-52.5	268	07	29	74	07.9	1388	38	102	3	0	99	X	X	99									8
31	8I	70-48.8	159-58.0	268	07	29	74	08.1	138C	38	101	3	0	99	X	X	99									C
31	8I	70-47.5	160-04.0	269	07	29	74	08.4	138D	40	106	3	0	99	X	X	99									D
31	8I	70-50.5	160-04.0	269	07	29	74	08.7	138E	50	132	3	0	99	X	X	99									E
31	8I	70-49.7	160-03.5	269	07	29	74	08.9	138F	28	074	3	0	99	X	X	99									F
31	8I	70-48.5	160-03.0	269	07	29	74	09.1	138G	40	107	3	0	99	X	X	99									G
31	8I	70-47.5	160-02.5	269	07	29	74	09.3	138H	32	085	3	0	99	X	X	99									H
31	8I	70-46.5	160-02.3	269	07	29	74	09.6	138I	27	071	3	0	99	X	X	99									I
31	BI	70-45.5	160-02.0	269	07	29	74	09.6	138J	22	059	3	0	99	X	X	99									J
31	8I	70-47.5	160-00.5	269	07	29	74	09.8	138K	23	058	3	0	99	X	X	99									K
31	8I	70-50.0	159-59.0	268	07	29	74	10.1	138L	32	083	3	0	99	X	X	99									L
31	8I	70-52.0	159-56.7	268	07	29	74	10.4	138M	40	104	3	0	99	X	X	99									M
31	BI	70-53.0	159-53.5	268	07	29	74	10.9	138N	37	097	3	0	99	X	X	99									N
31	8I	70-54.0	159-49.0	268	07	29	74	12.0	139A	32	085	3	8	99	X	X	99									A



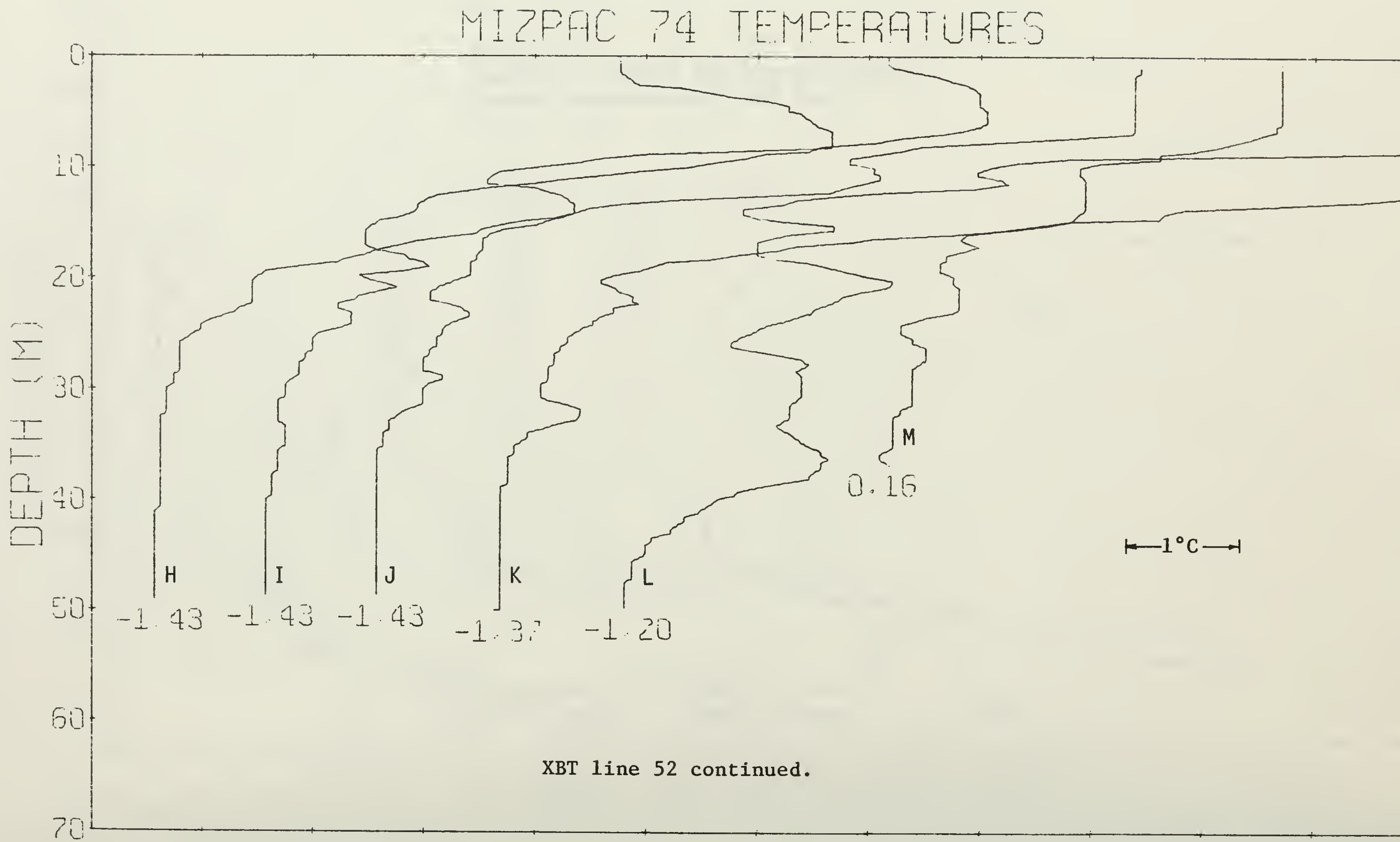
Nested temperatures along XBT line 33. Indicated numbers are bottom temperatures.



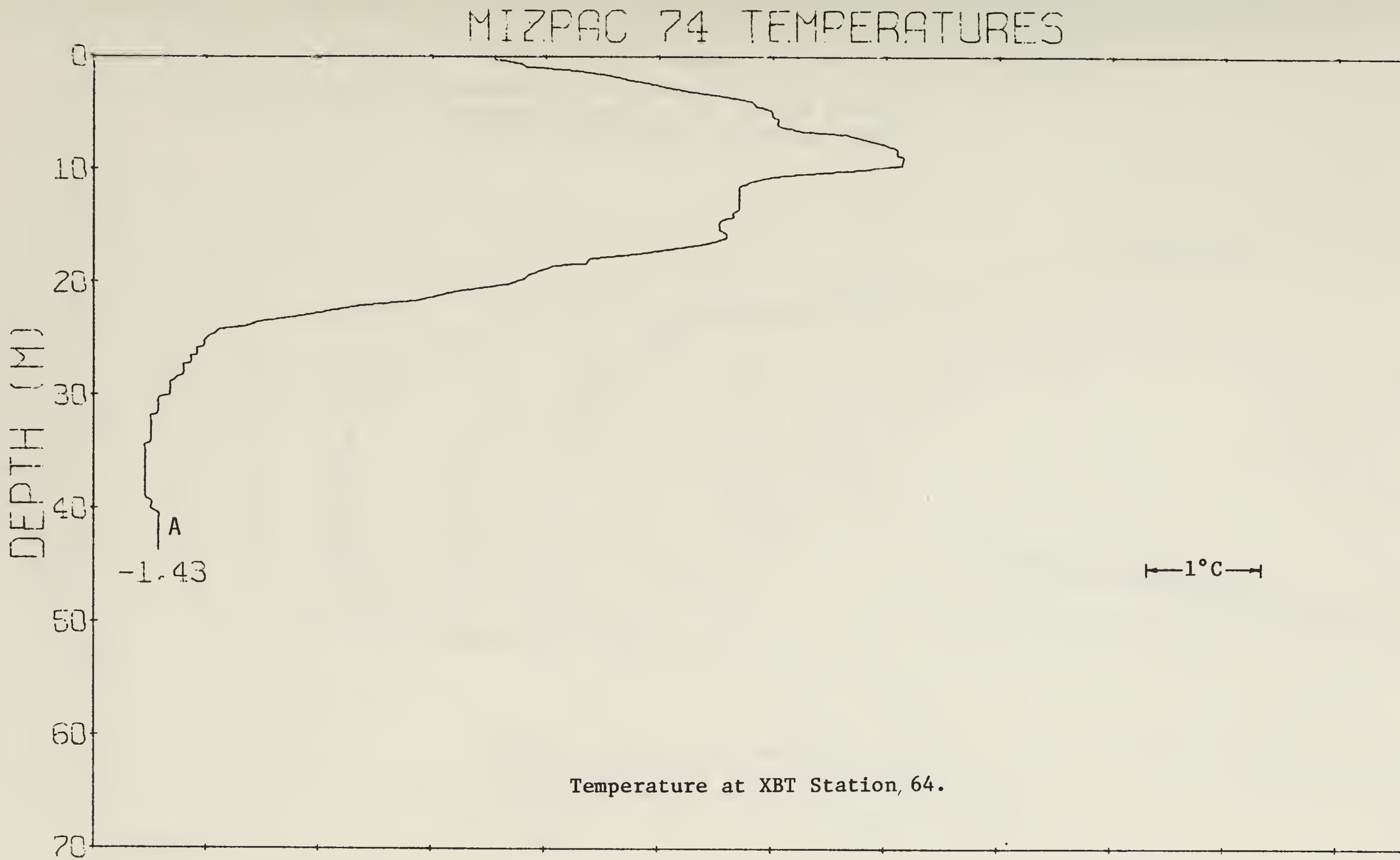
Nested temperatures along XBT line 42. Indicated numbers are bottom temperatures.



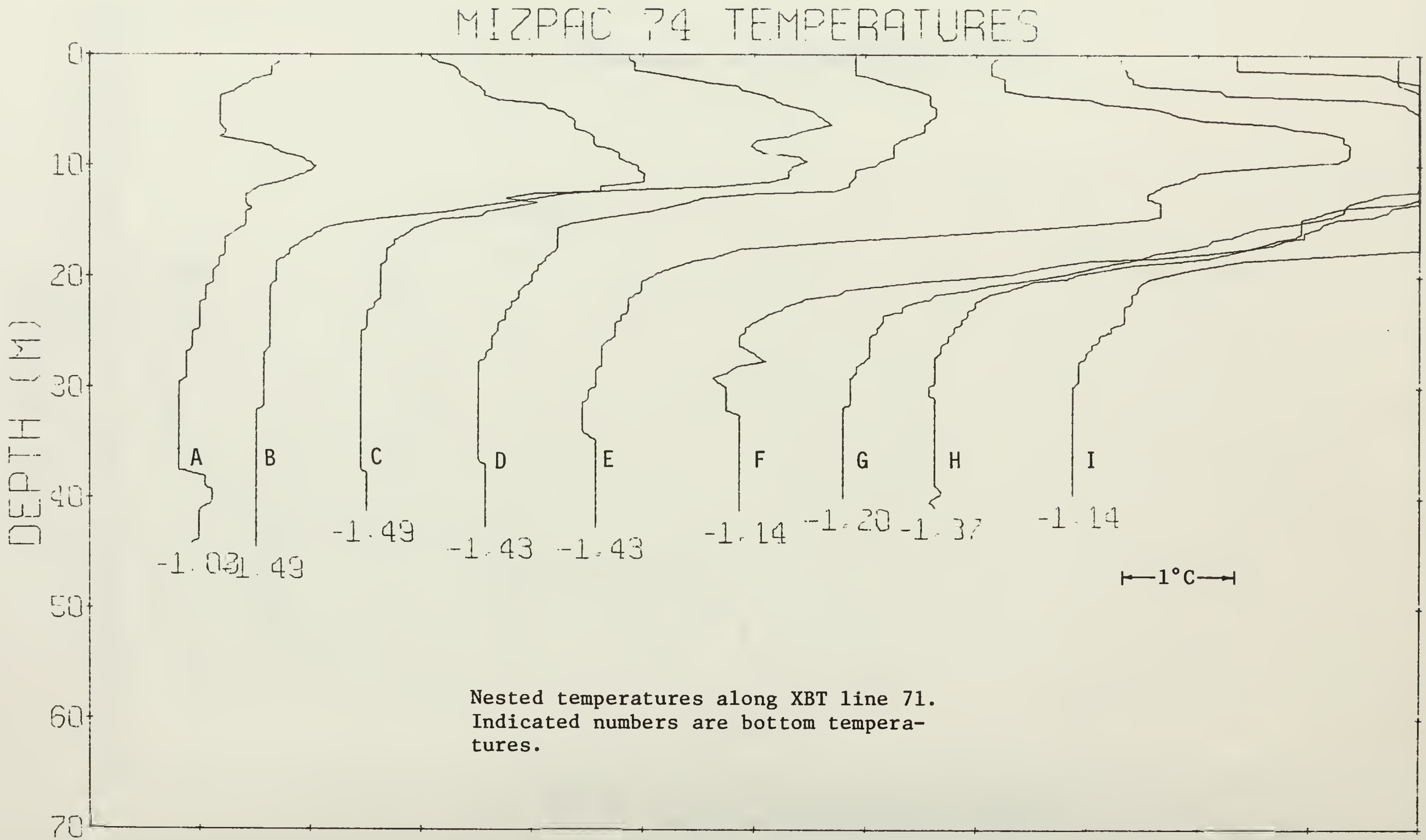
Nested temperatures along XBT line 52. Indicated numbers are bottom temperatures.



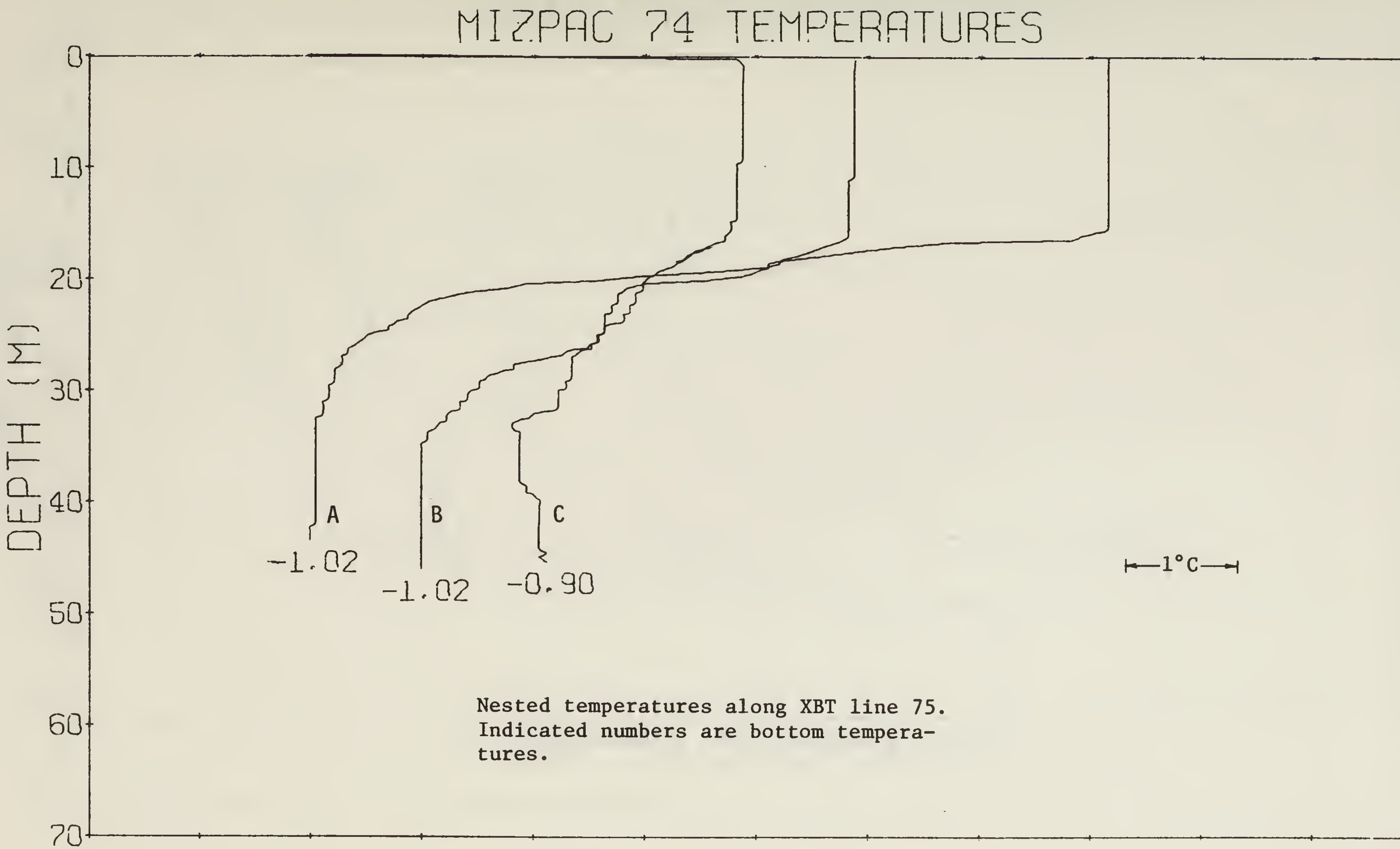
XBT line 52 continued.



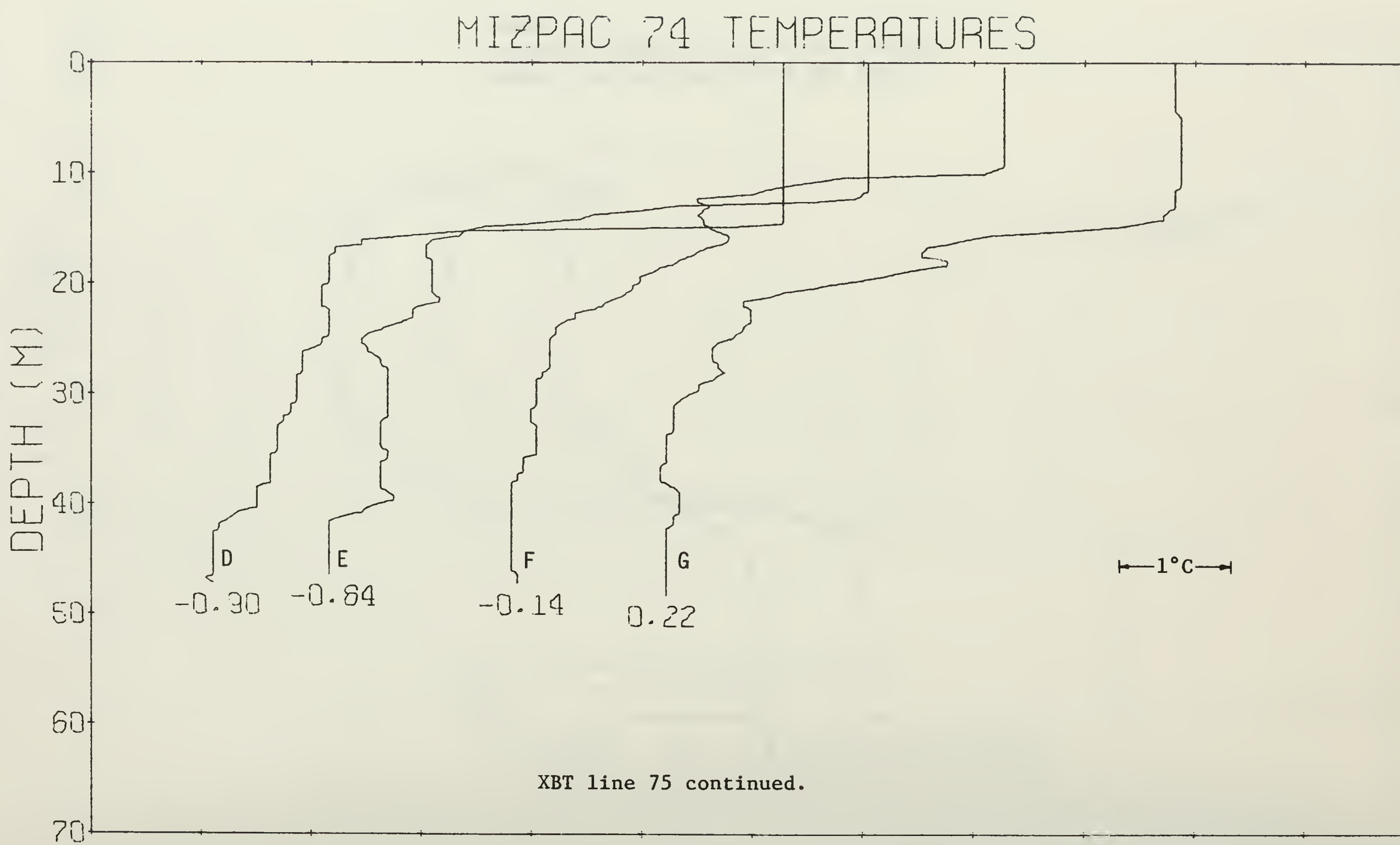
Temperature at XBT Station, 64.



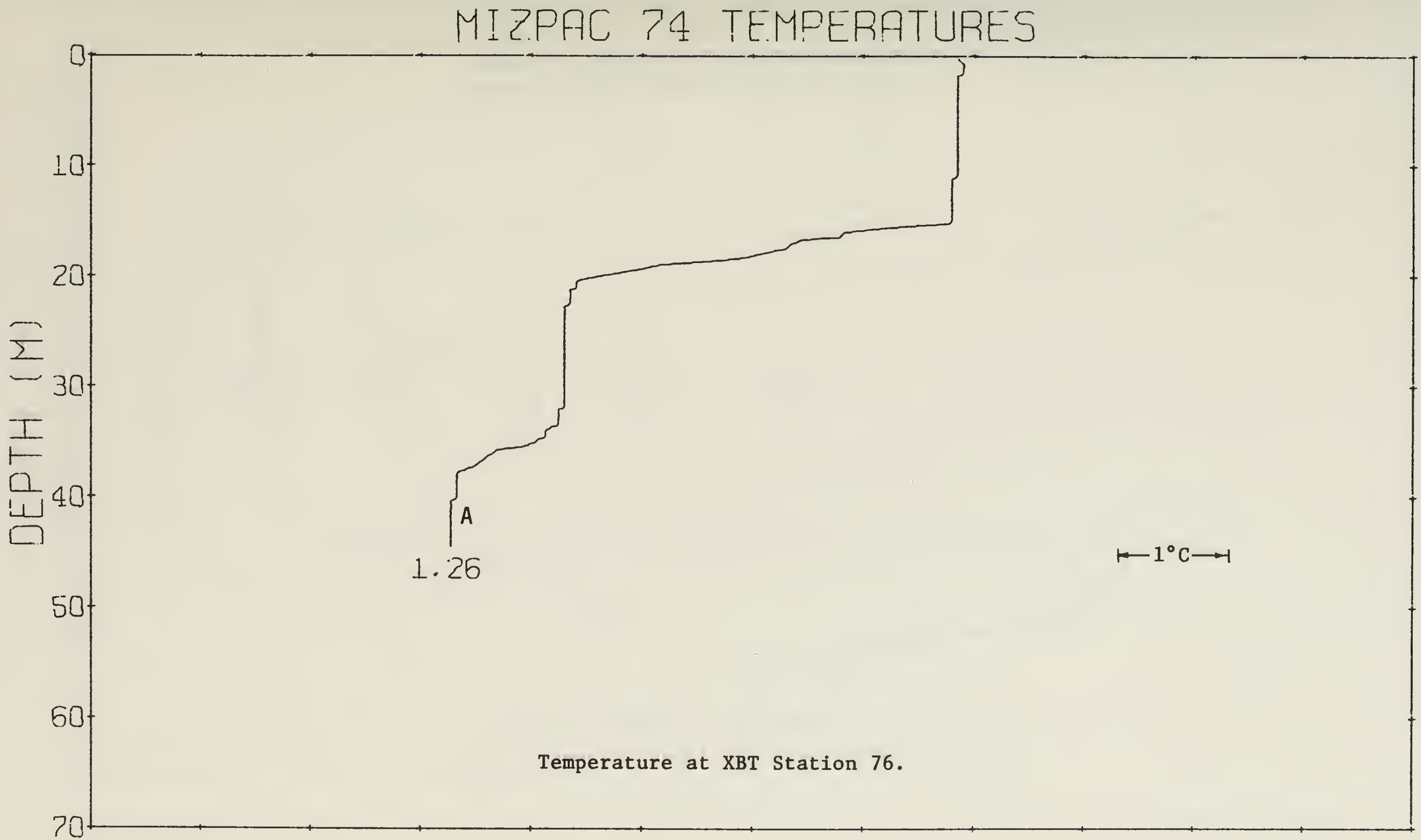
Nested temperatures along XBT line 71. Indicated numbers are bottom temperatures.



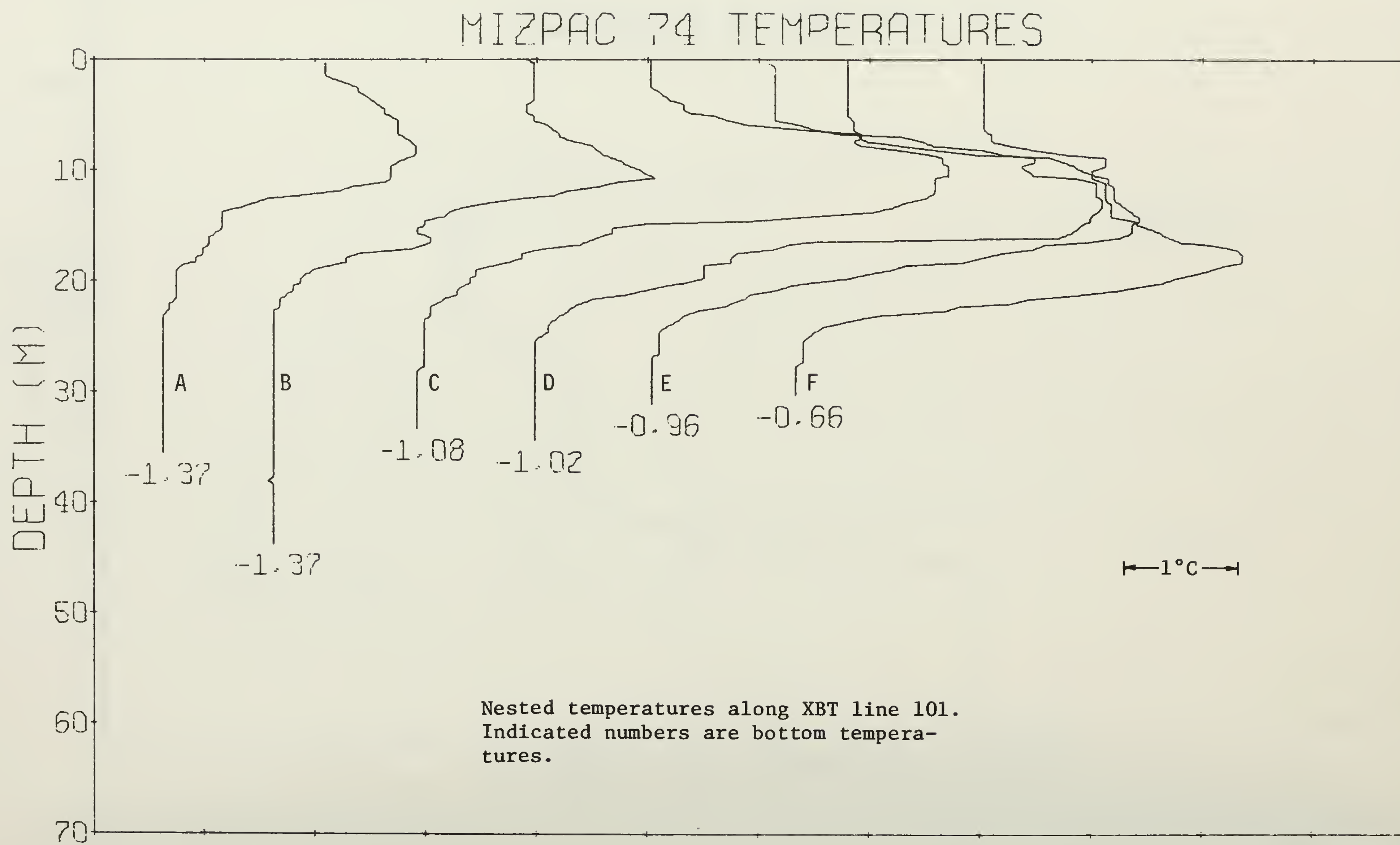
Nested temperatures along XBT line 75. Indicated numbers are bottom temperatures.



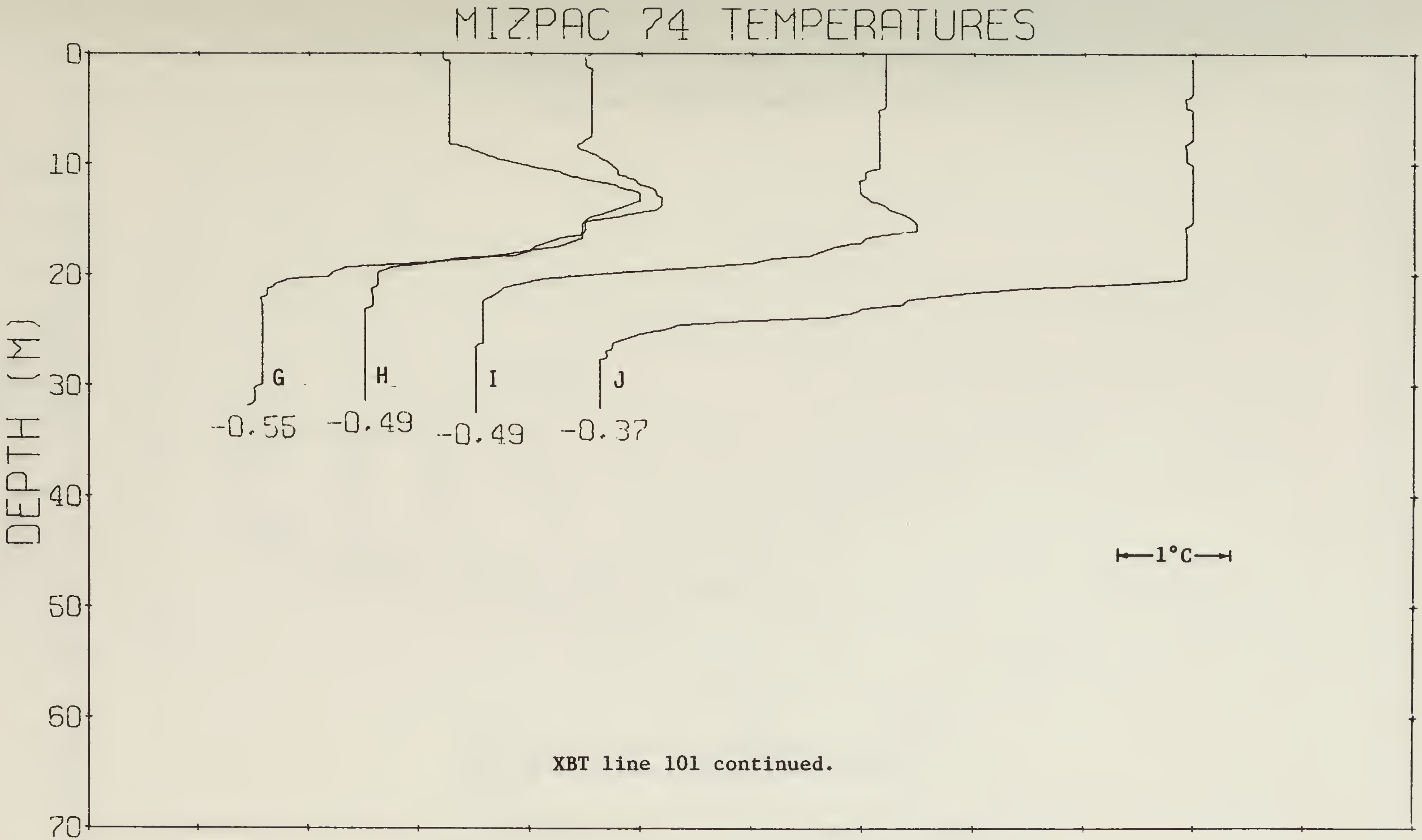
XBT line 75 continued.



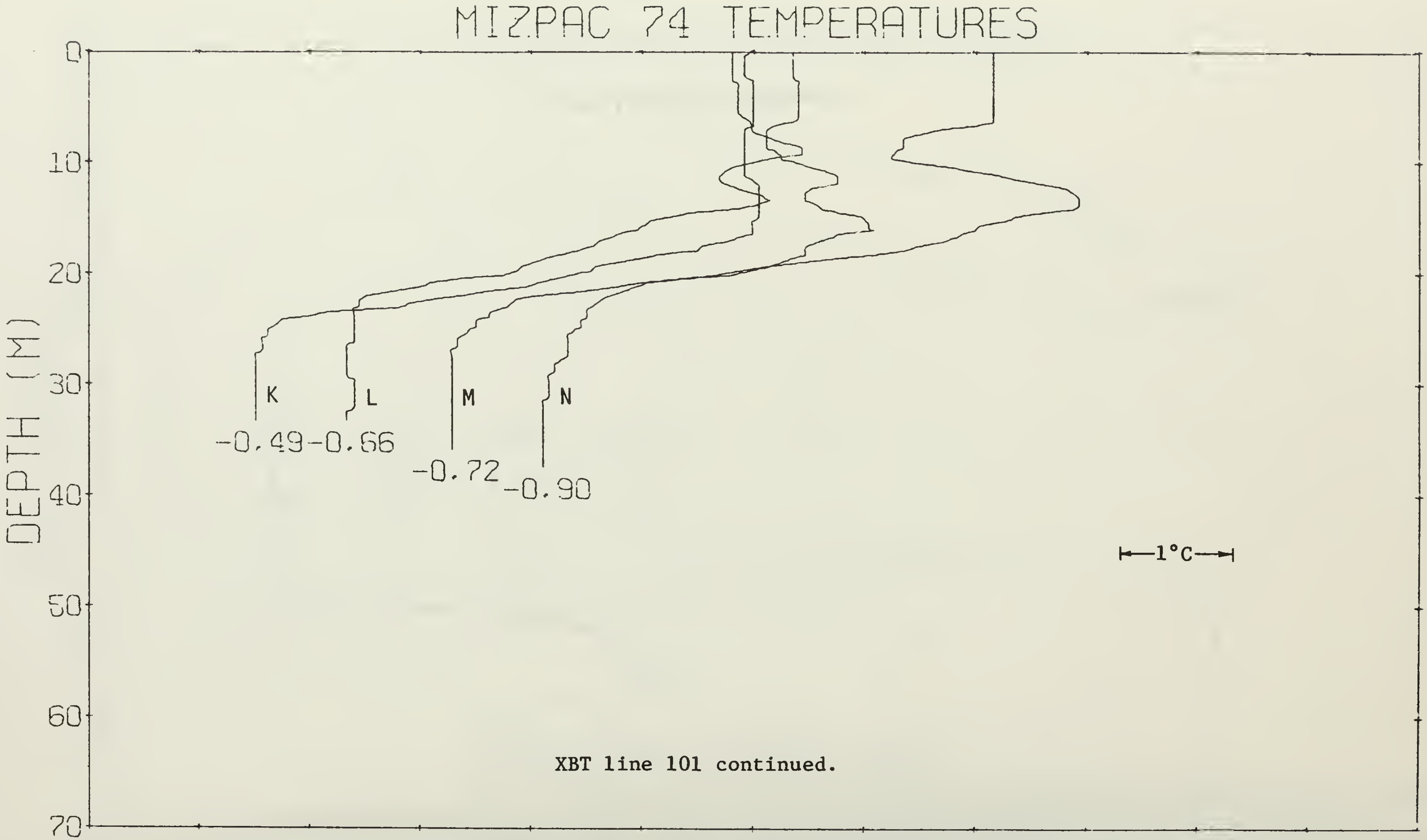
Temperature at XBT Station 76.



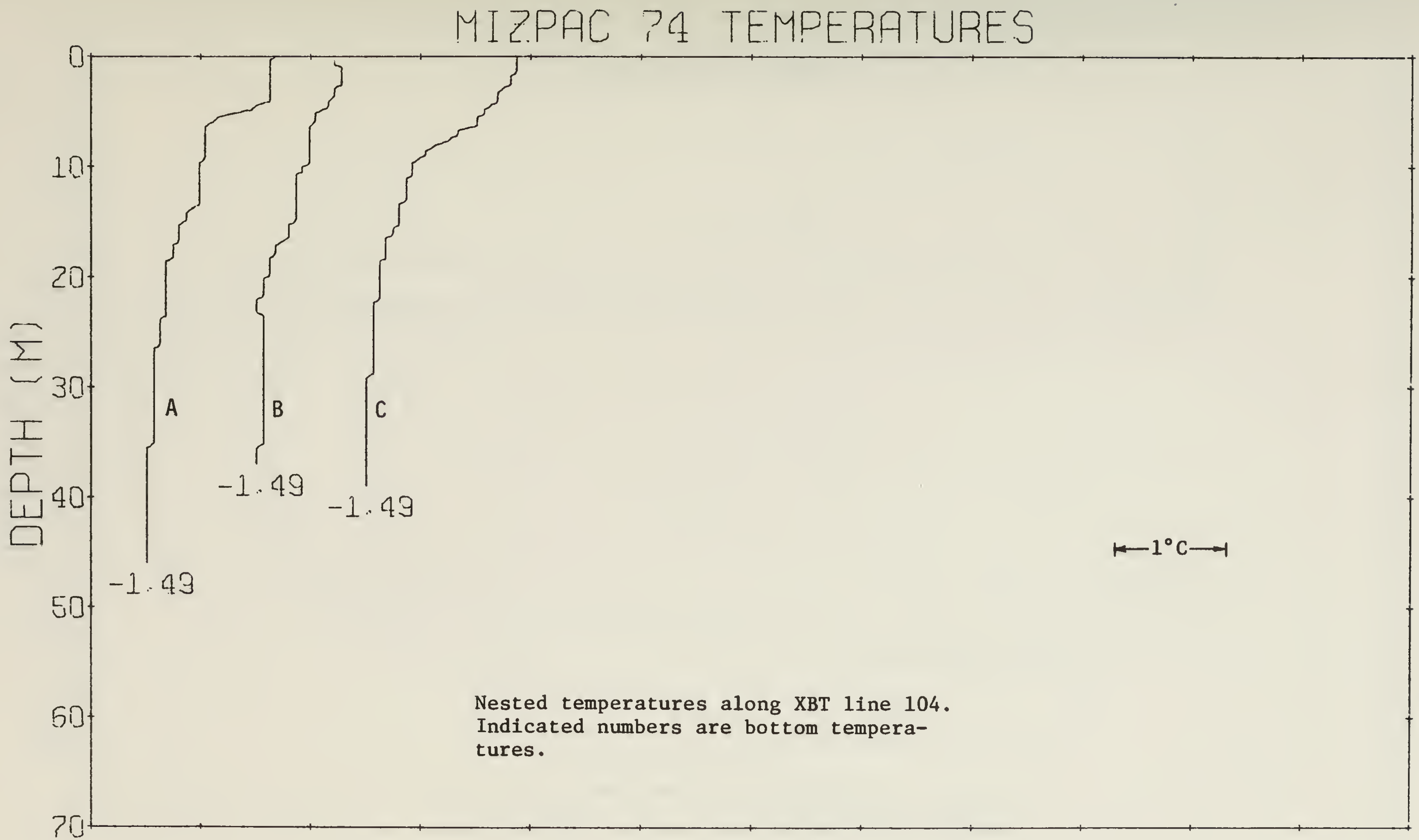
Nested temperatures along XBT line 101. Indicated numbers are bottom temperatures.



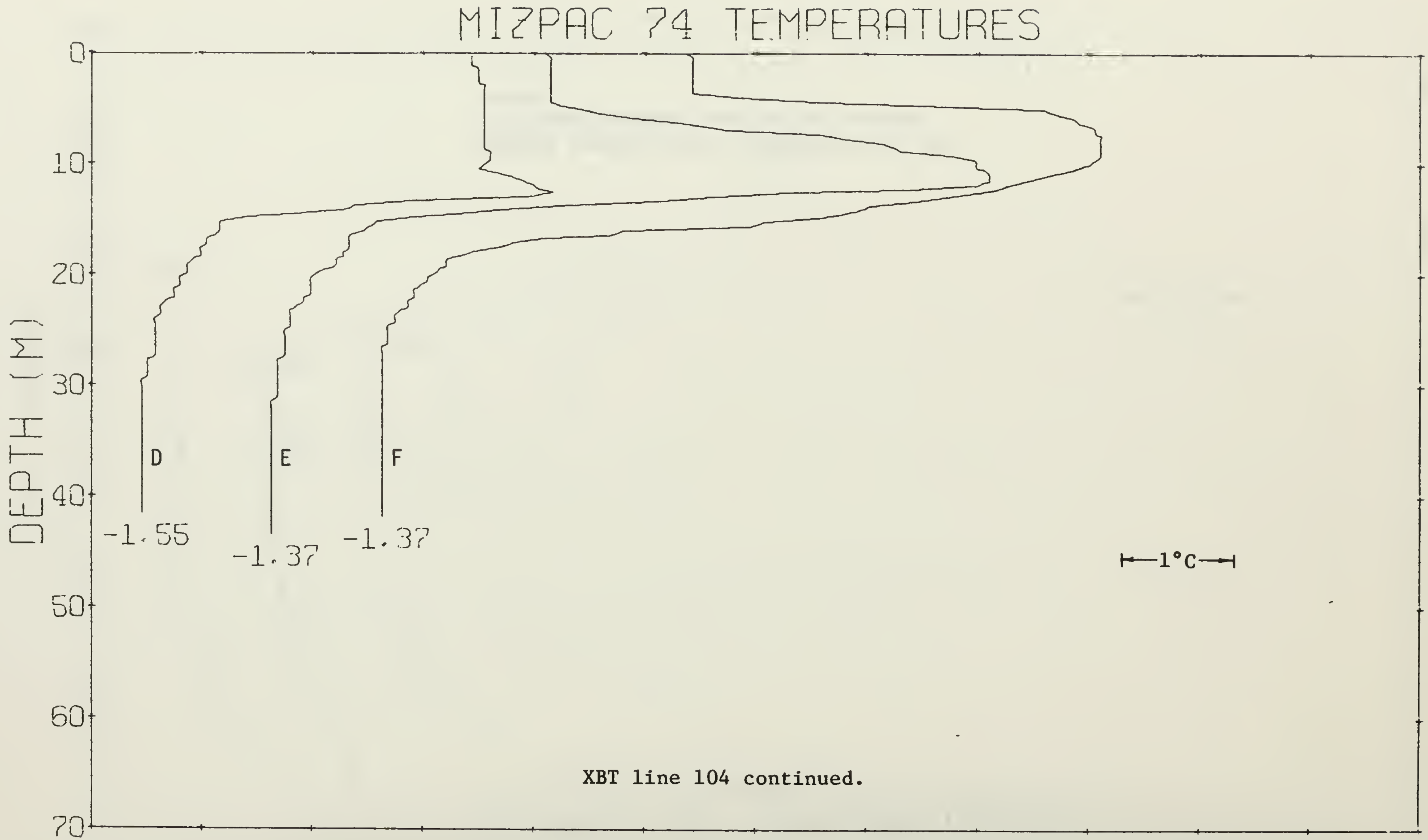
XBT line 101 continued.



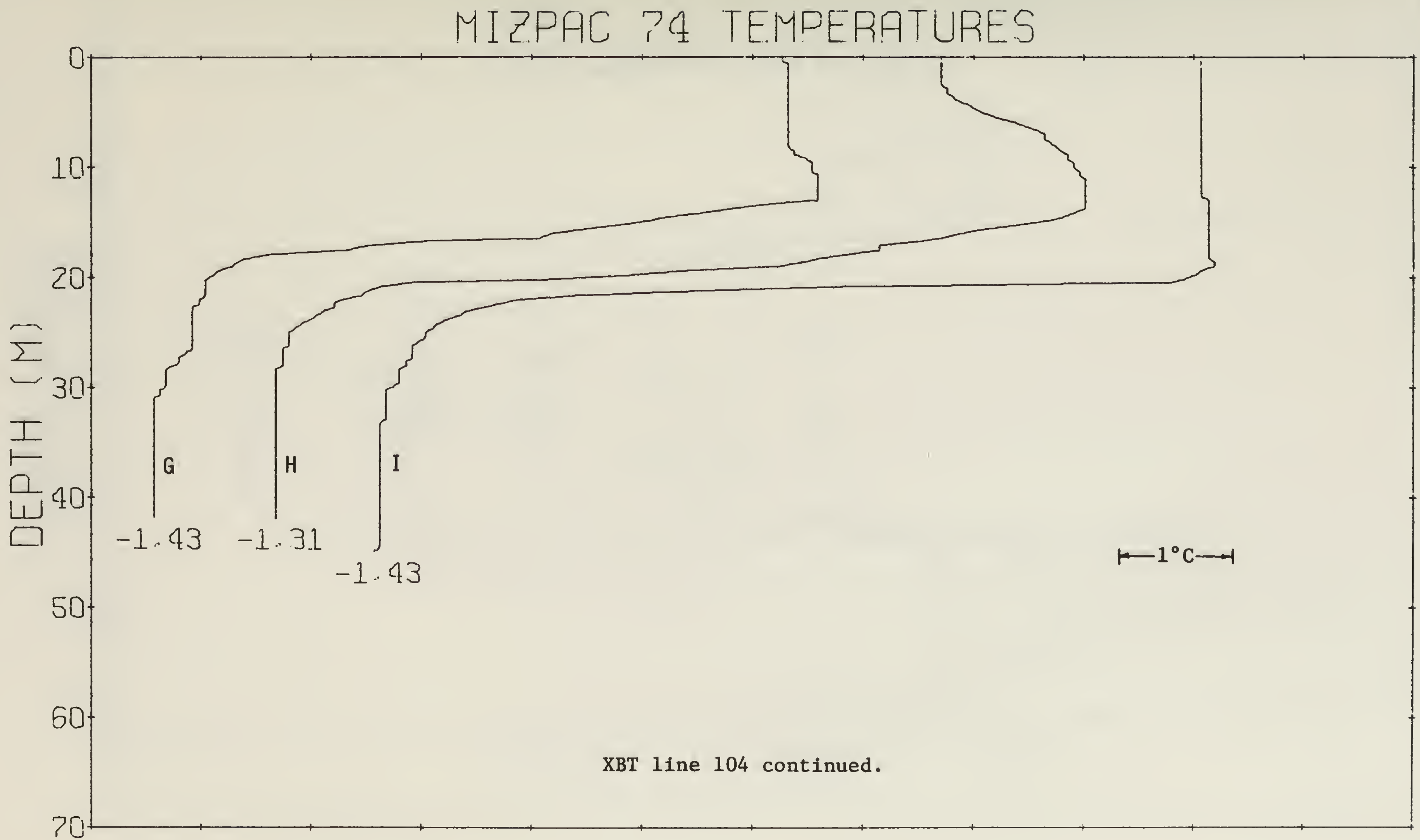
XBT line 101 continued.



Nested temperatures along XBT line 104. Indicated numbers are bottom temperatures.

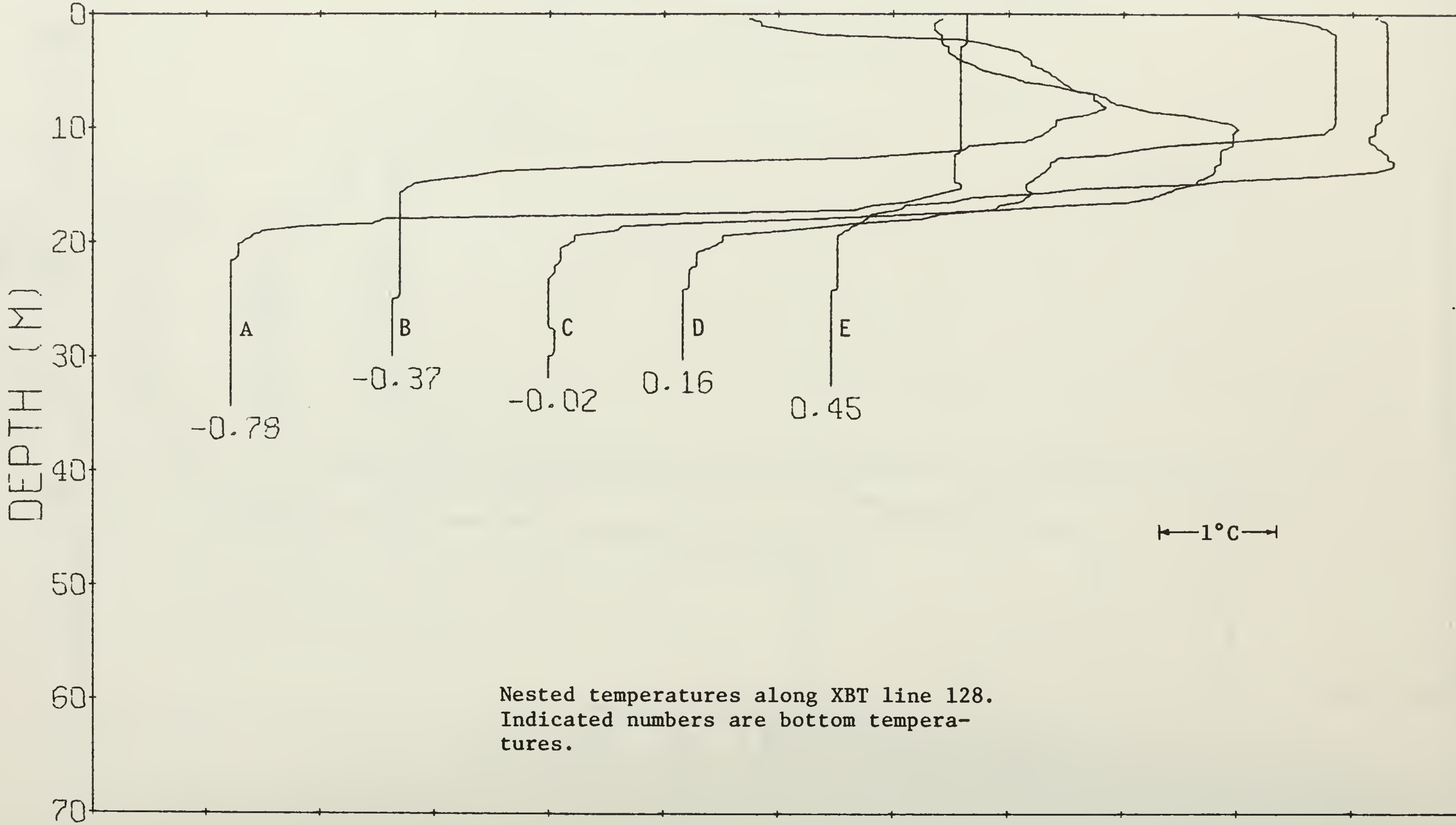


XBT line 104 continued.

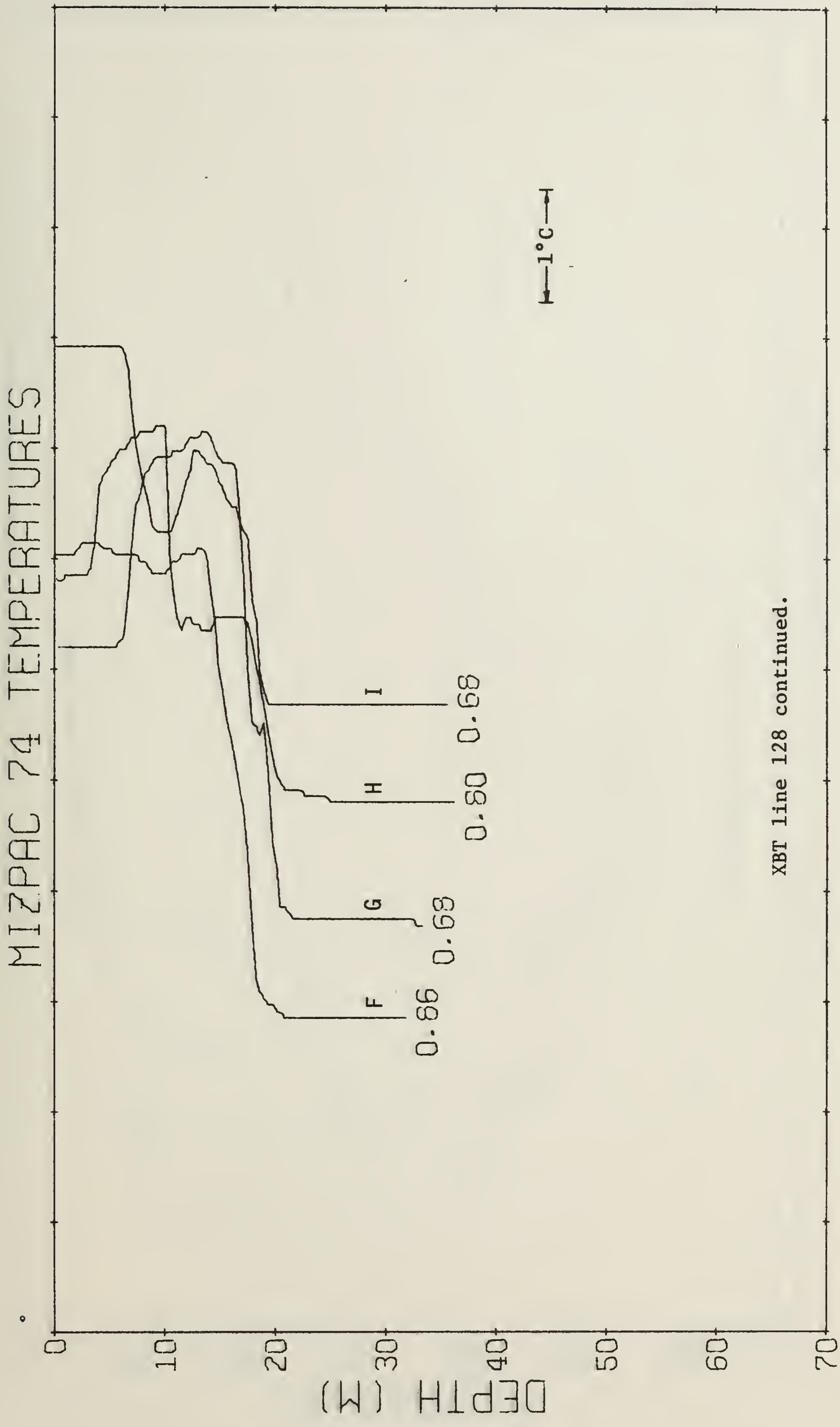


XBT line 104 continued.

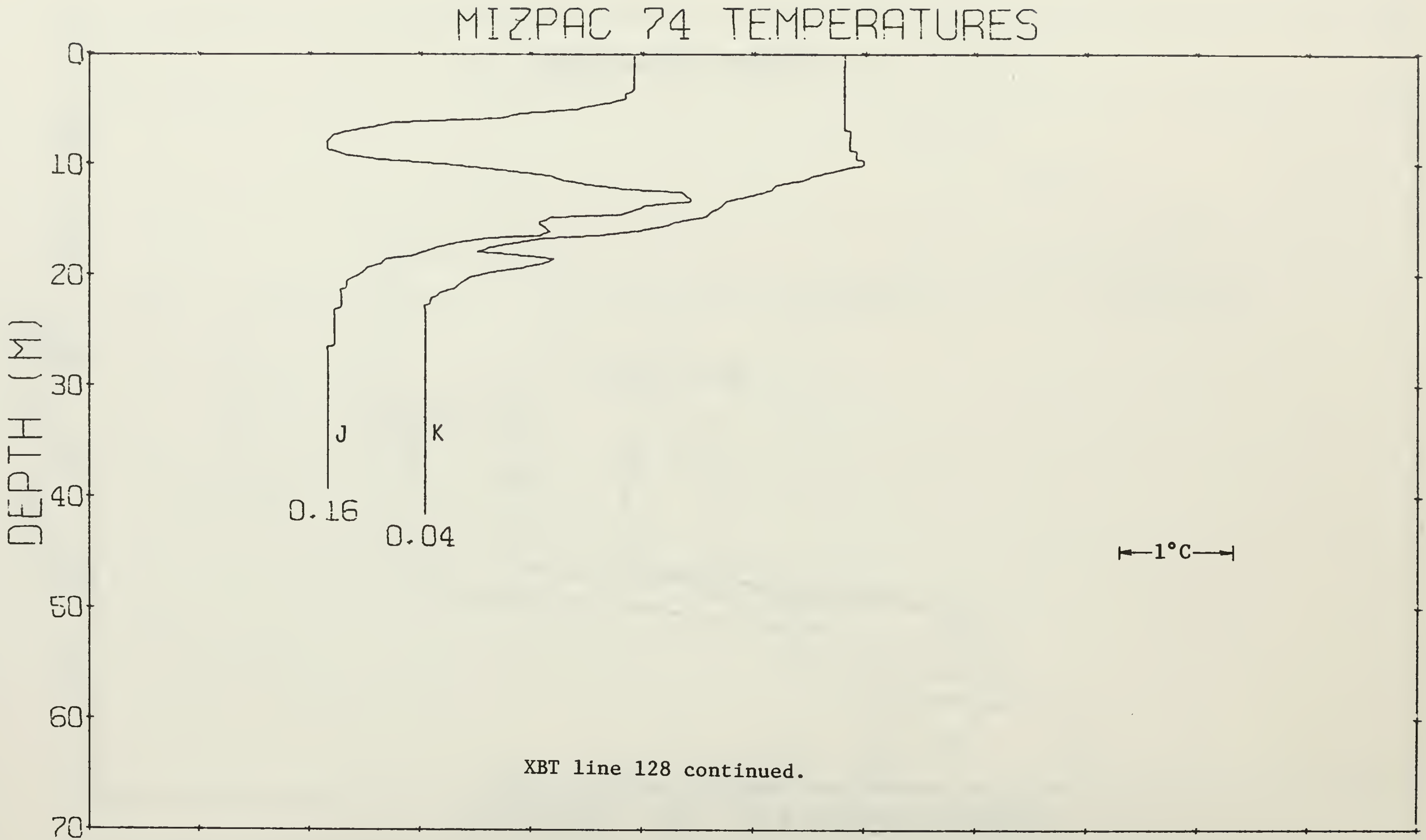
MIZPAC 74 TEMPERATURES



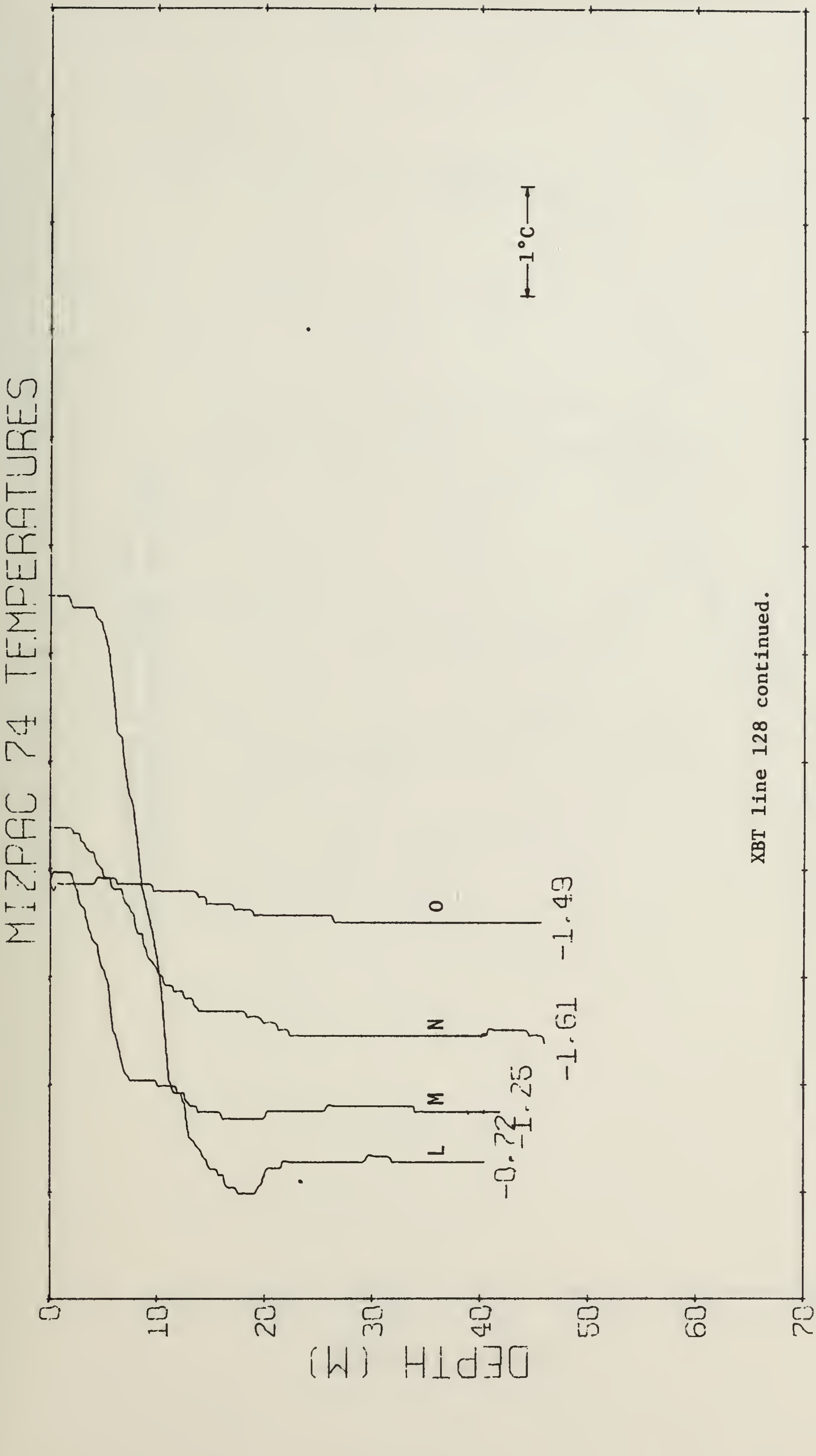
Nested temperatures along XBT line 128. Indicated numbers are bottom temperatures.



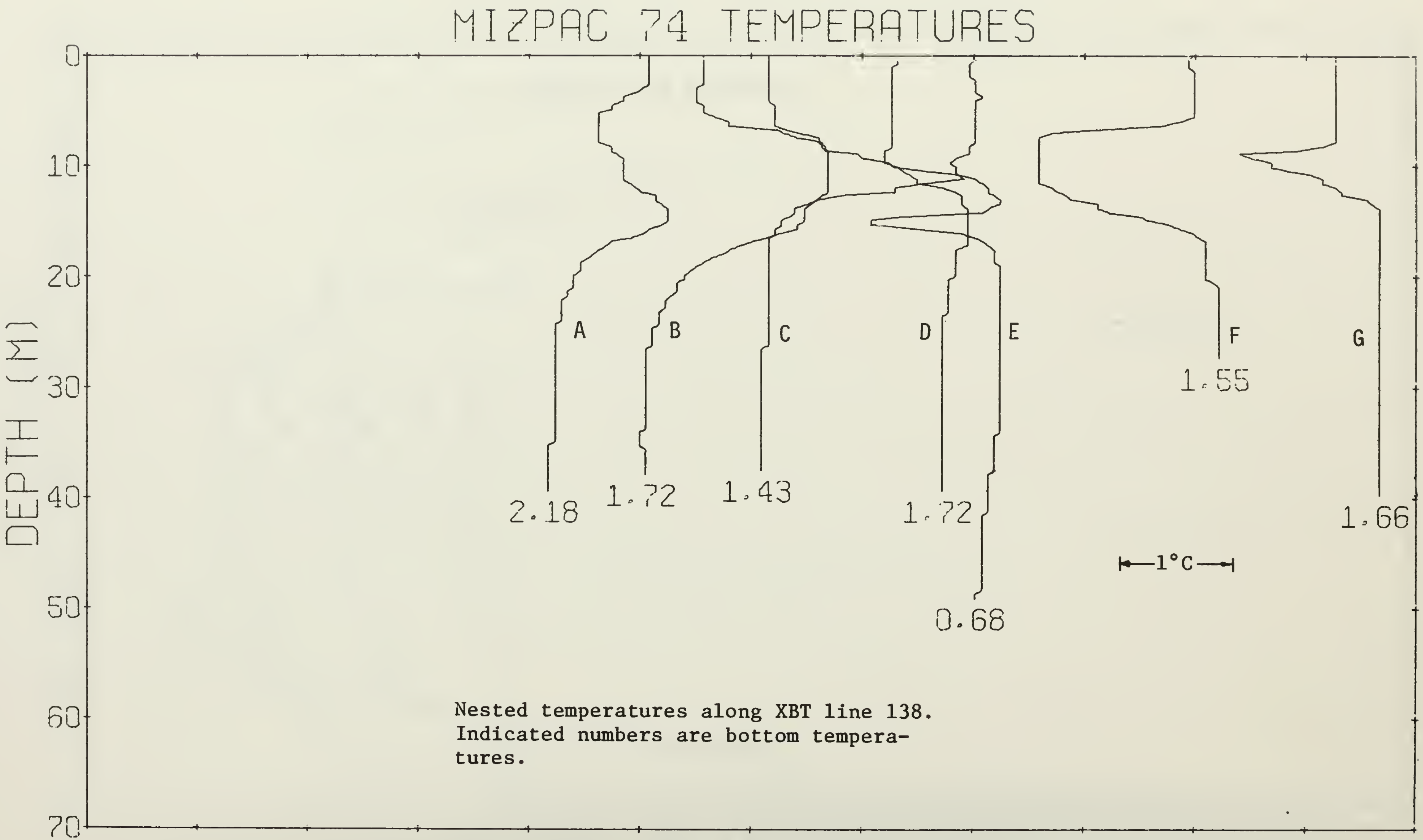
XBT line 128 continued.



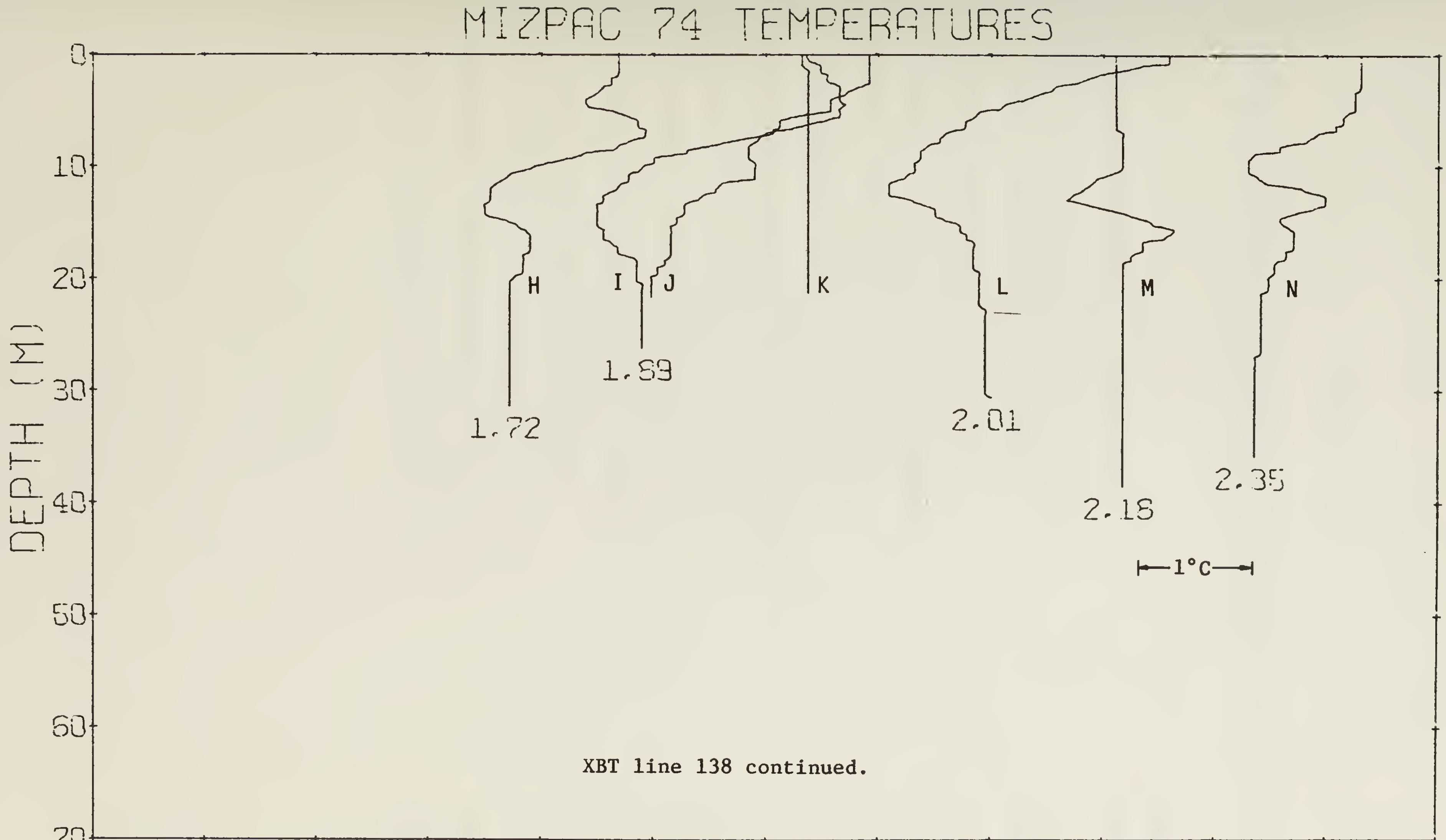
XBT line 128 continued.



XBT line 128 continued.



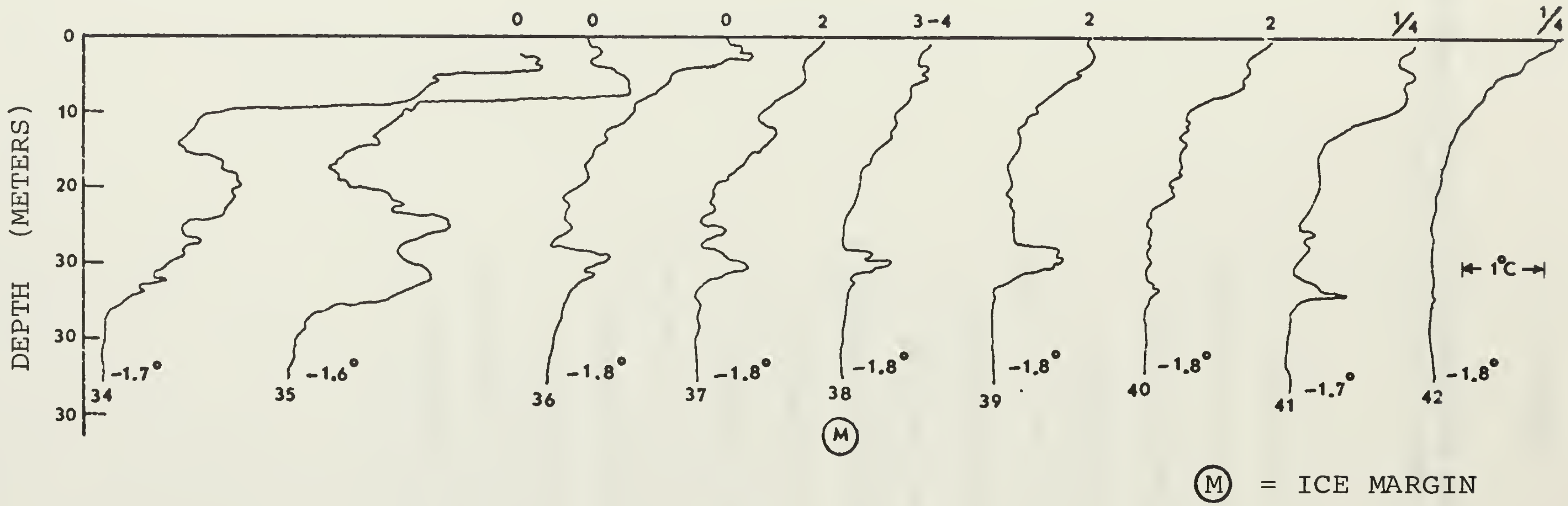
Nested temperatures along XBT line 138. Indicated numbers are bottom temperatures.



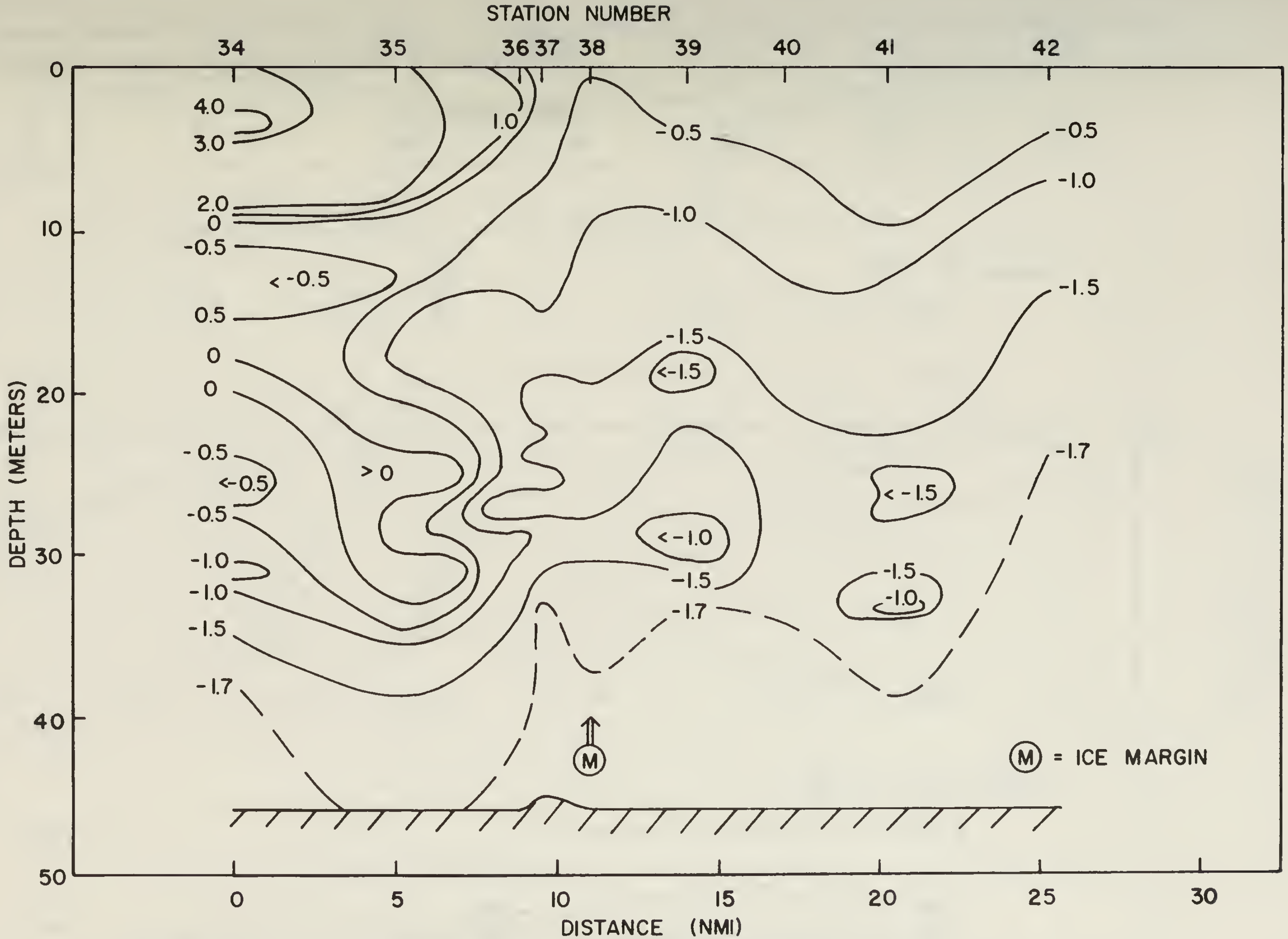
XBT line 138 continued.

APPENDIX IV

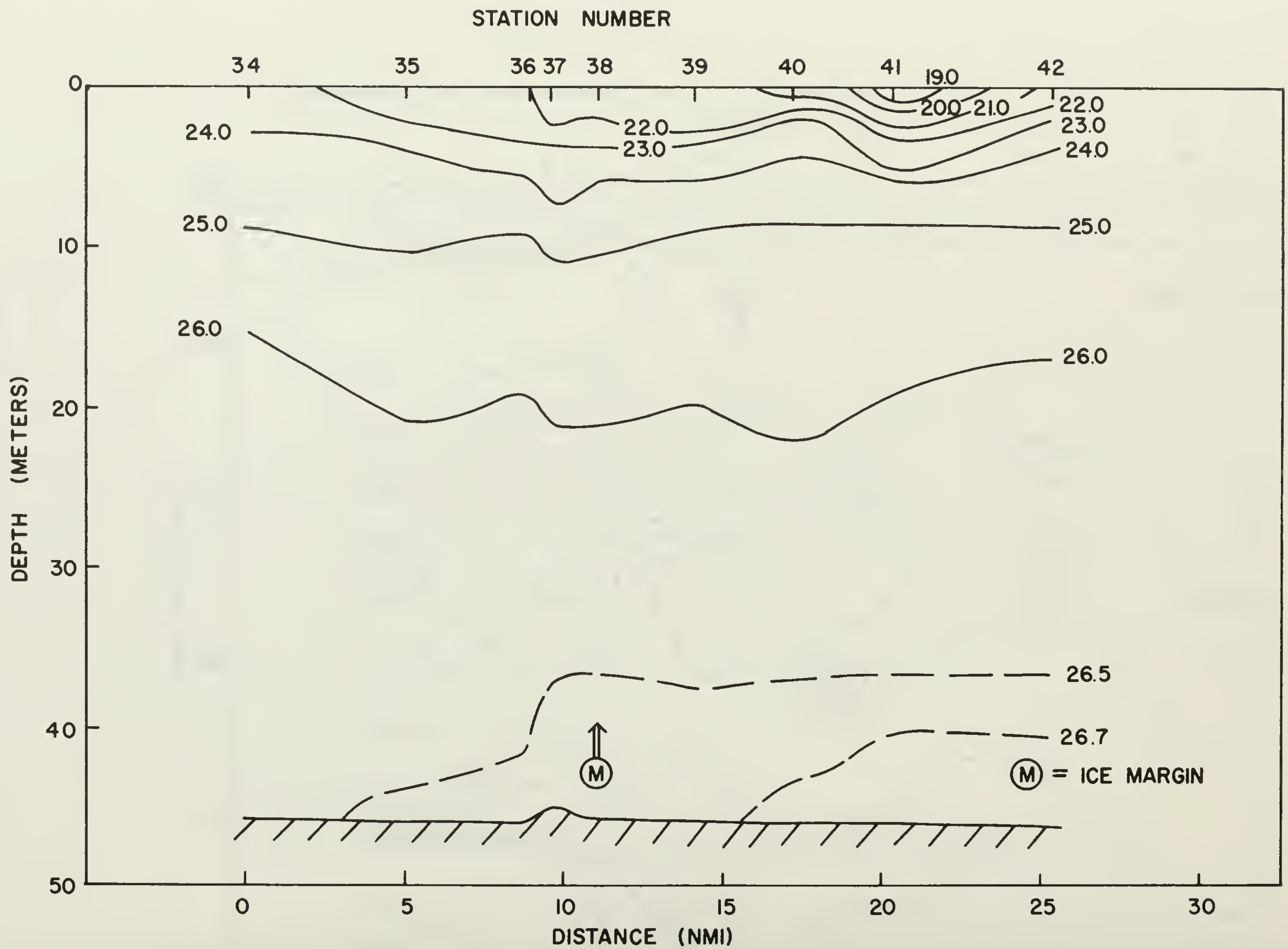
TEMPERATURE PROFILES AND TEMPERATURE AND SIGMA-T CROSS-SECTIONS FOR ICE MARGIN CROSSINGS 2-5 AND 7



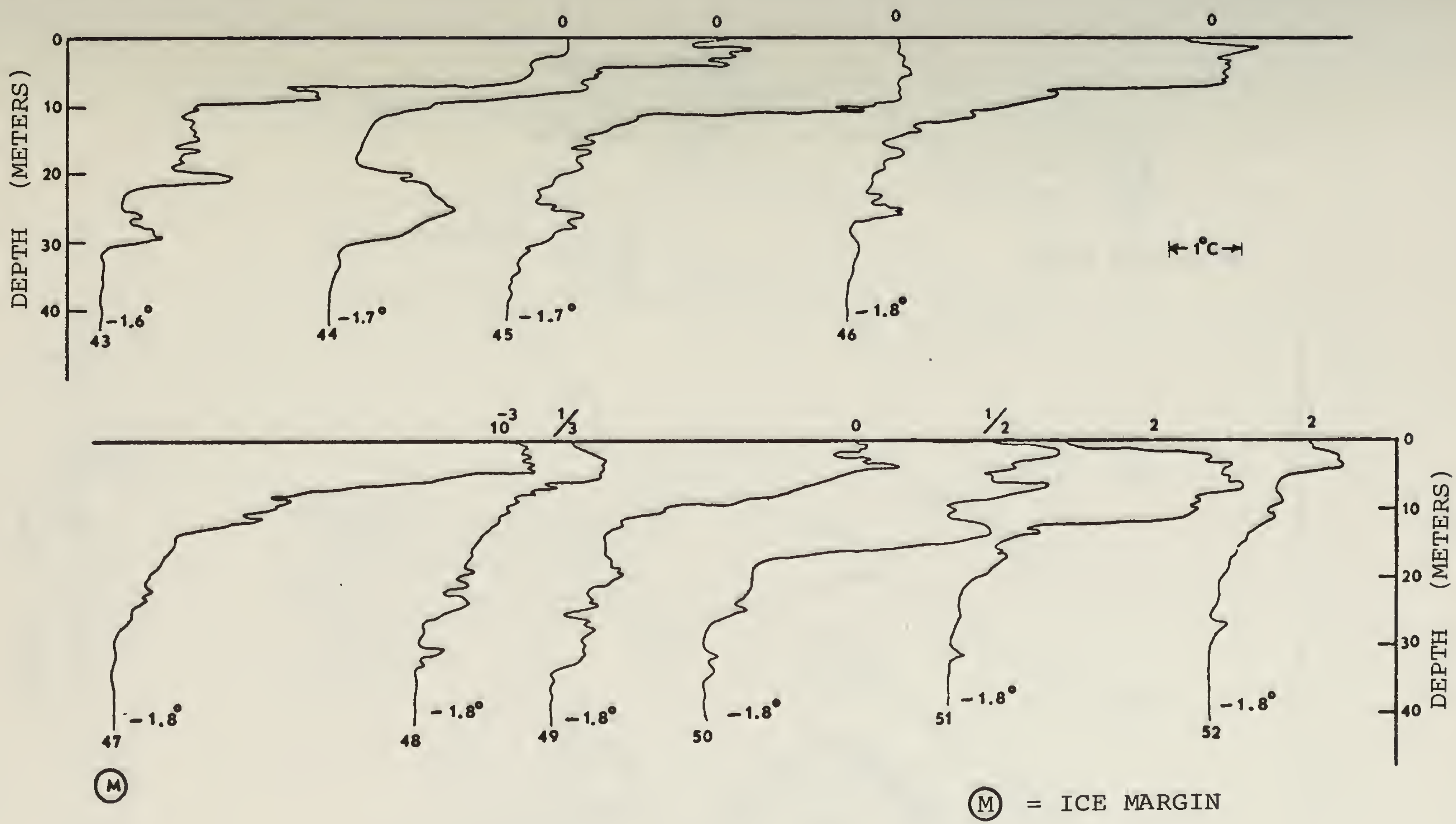
Temperature profiles for Crossing 2.
Numbers at the top of trace are ice concentrations;
at the bottom of the trace the bottom temperature.



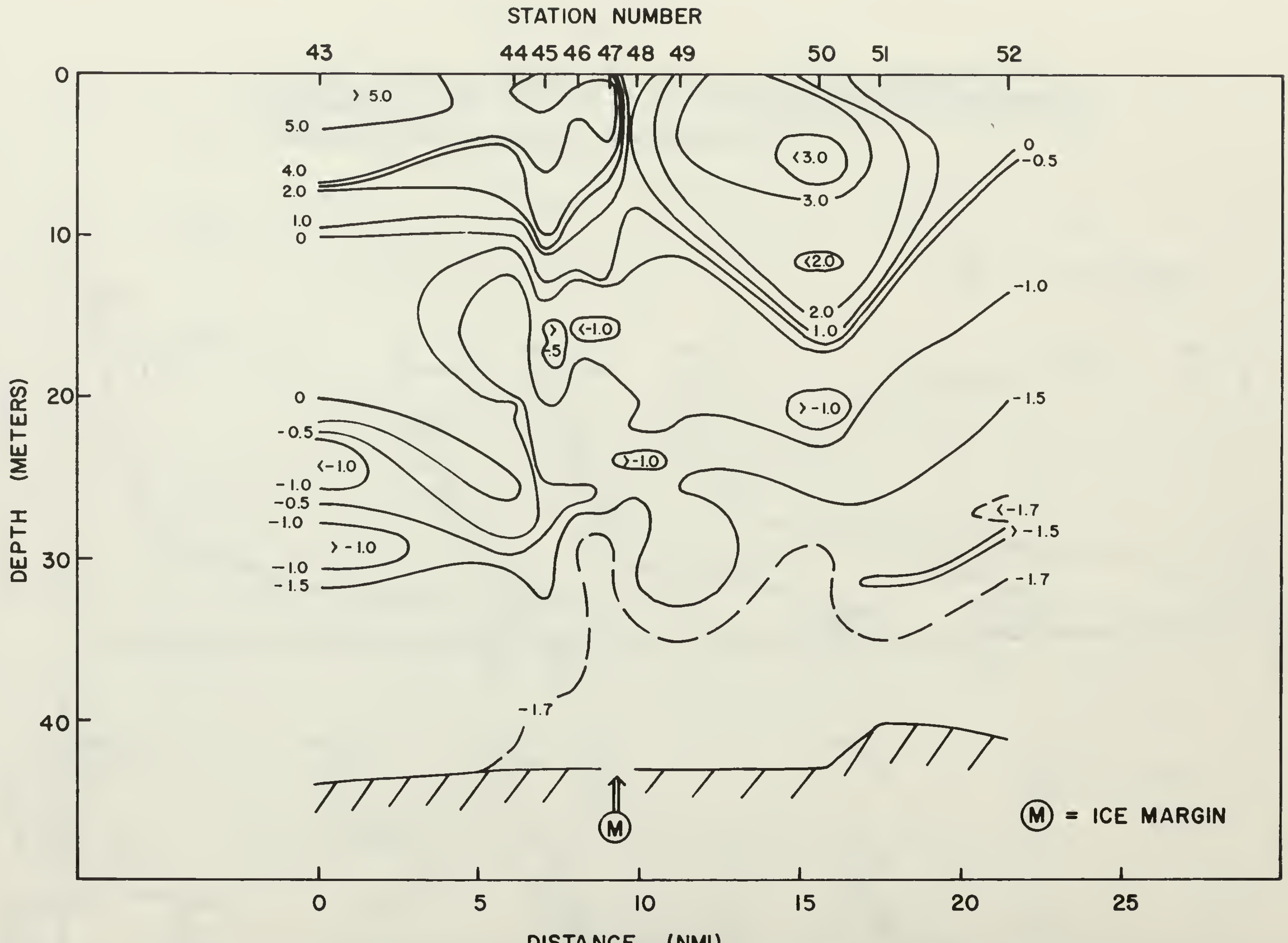
Temperature cross-section for Crossing 2.



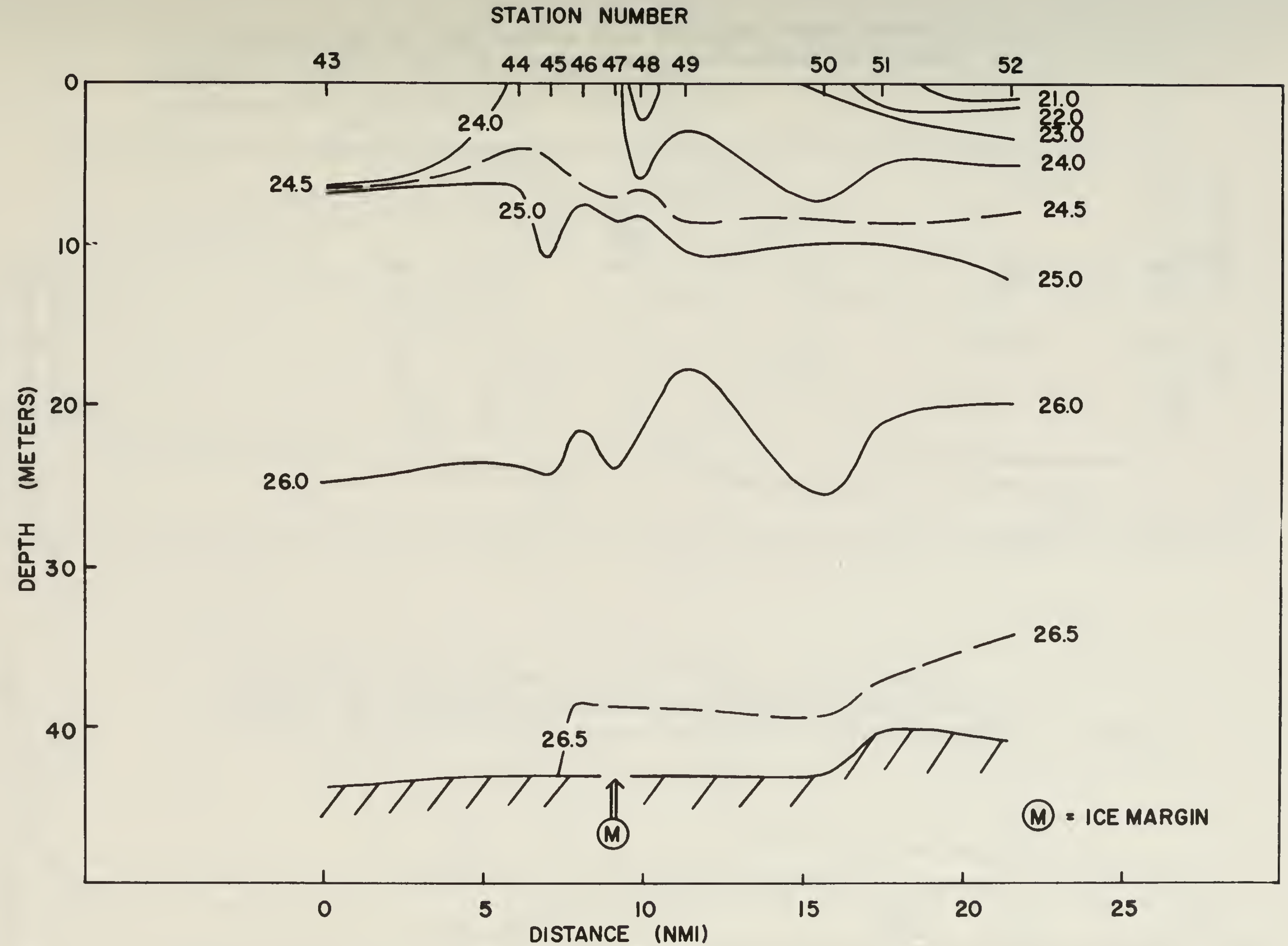
Sigma-t cross-section for Crossing 2.



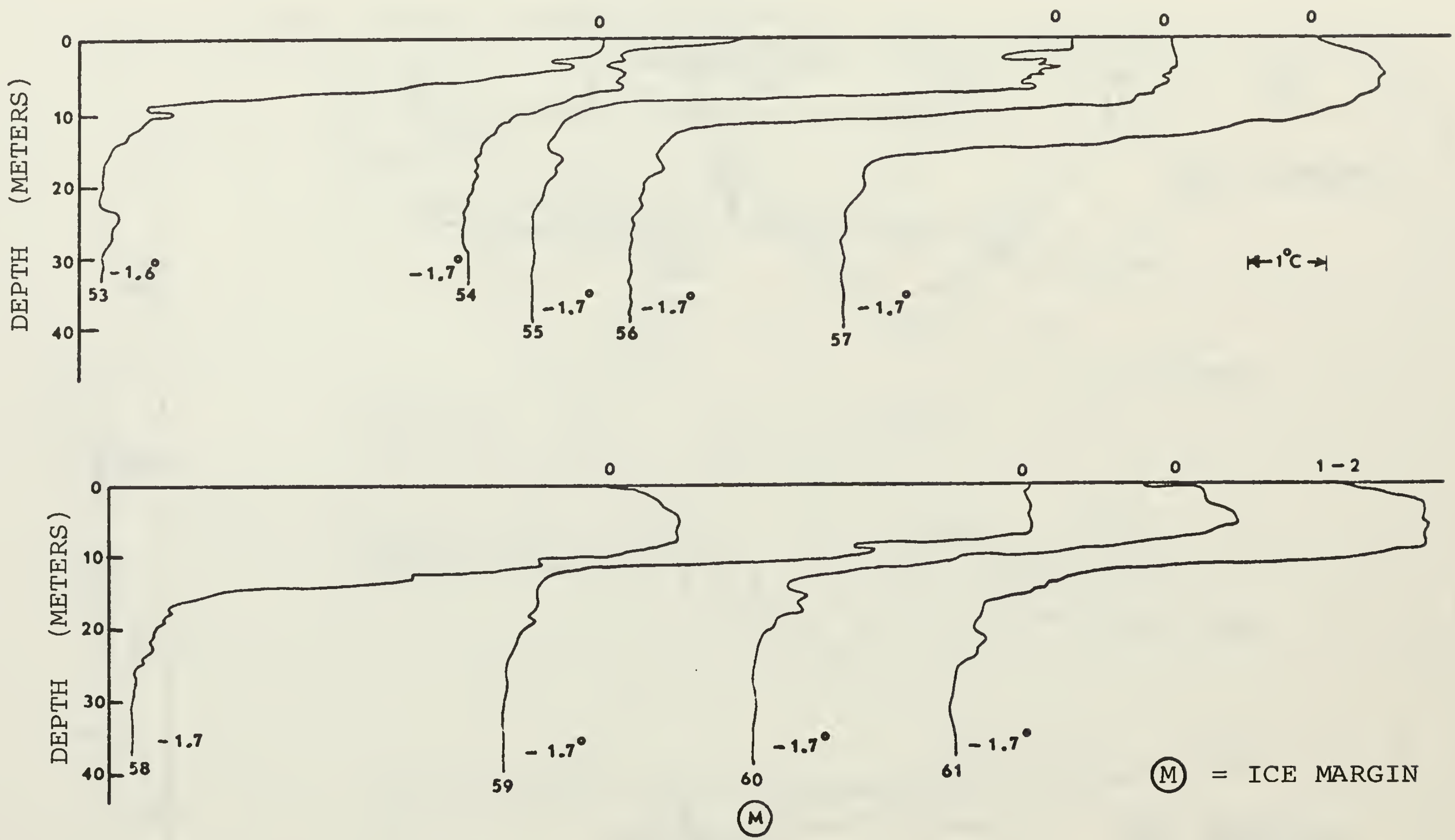
Temperature profiles for Crossing 3.
Numbers at the top of trace are ice concentrations;
at the bottom of the trace the bottom temperature.



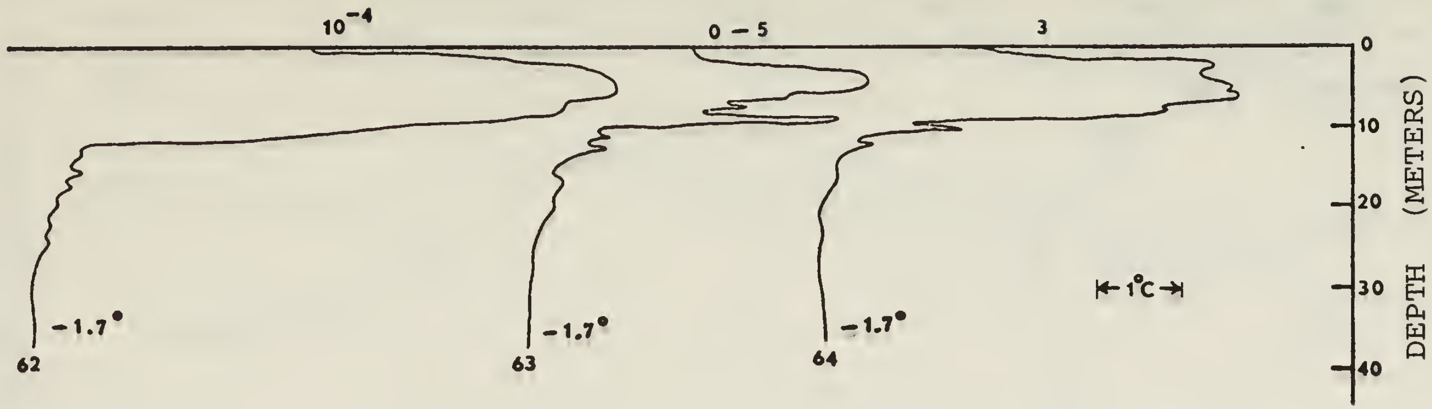
Temperature cross-section for Crossing 3.



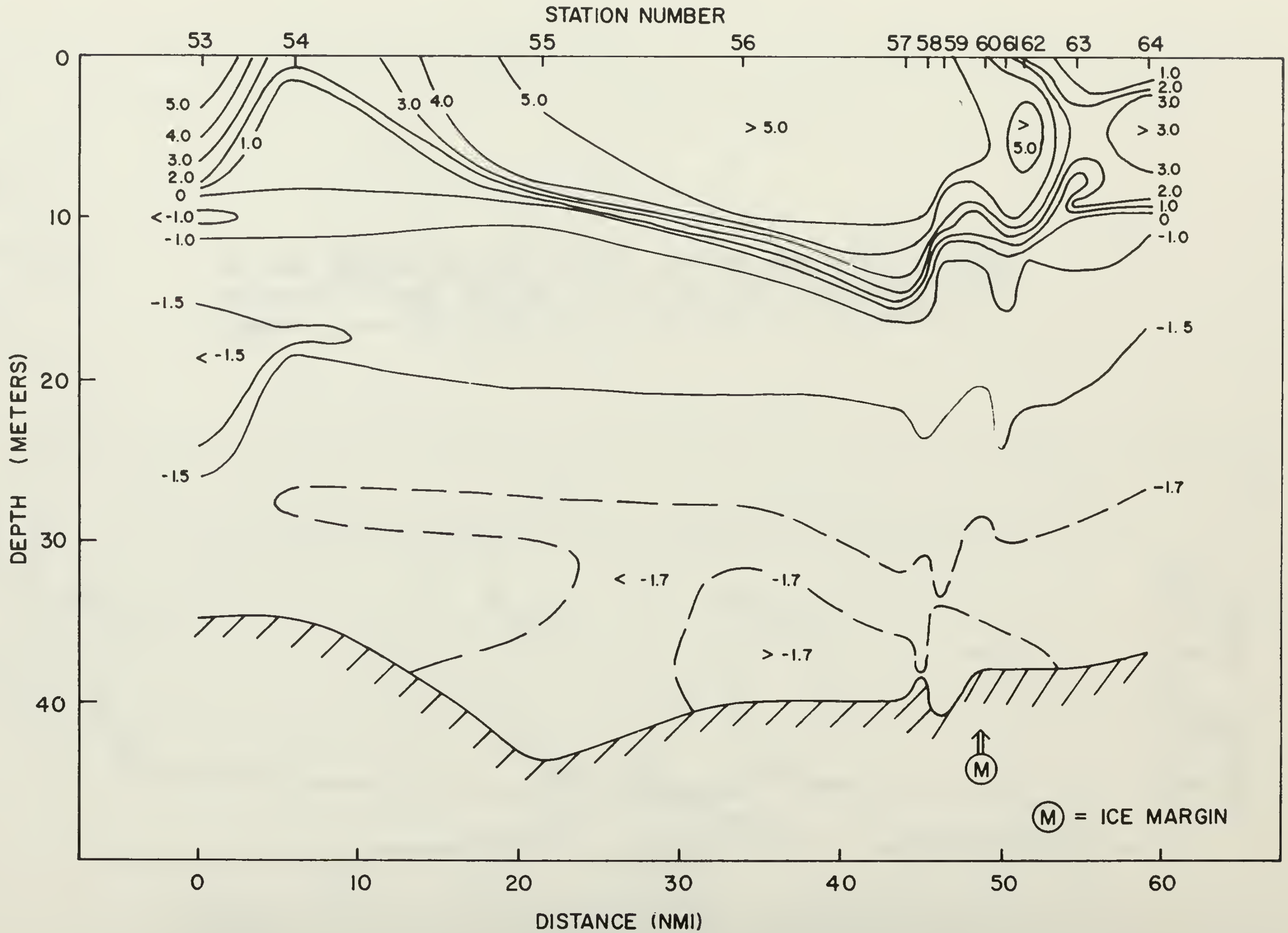
Sigma-t cross-section for Crossing 3.



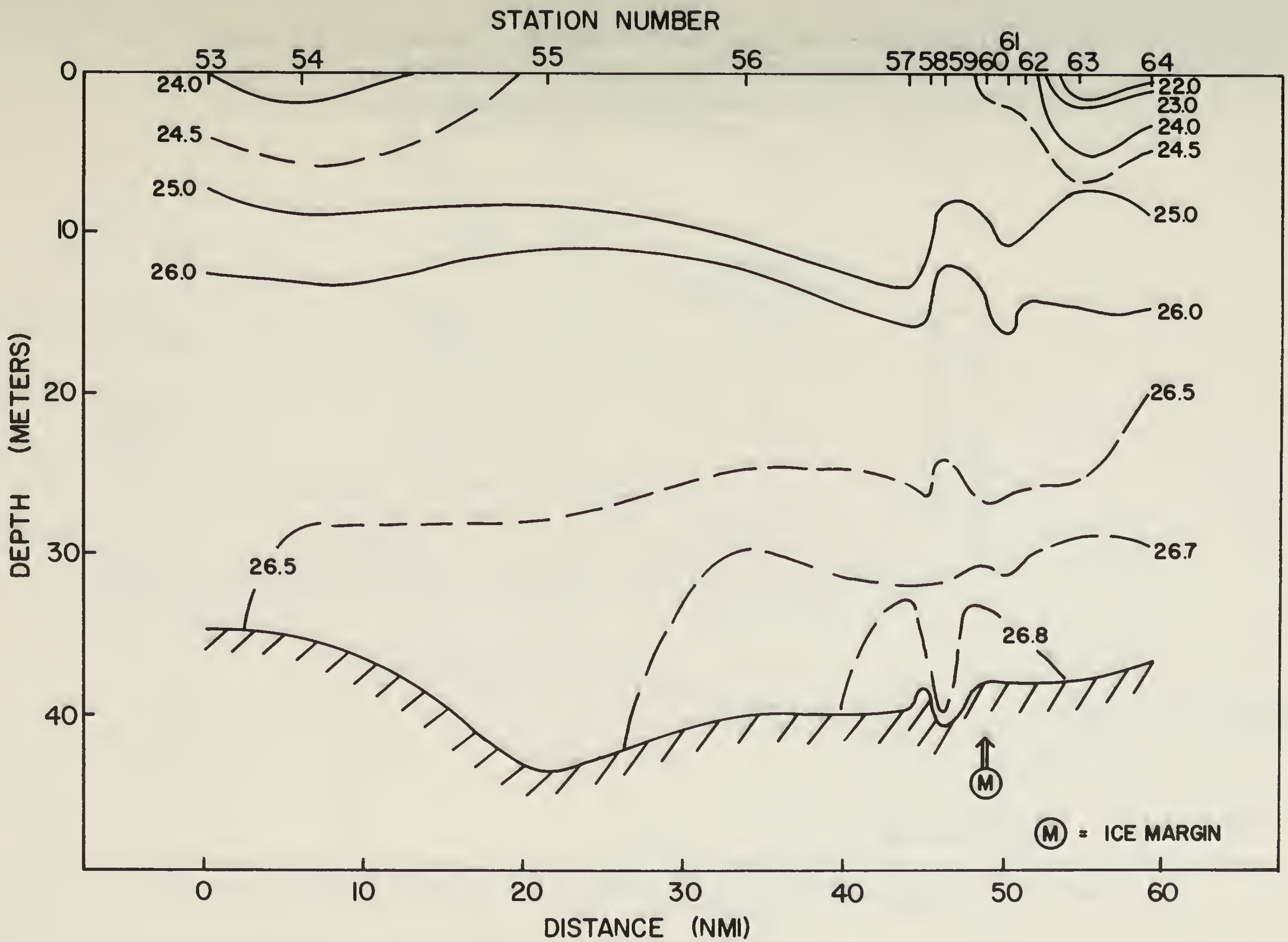
Temperature profiles for Crossing 4.
Numbers at the top of trace are ice concentrations; at the bottom of the trace the bottom temperature.



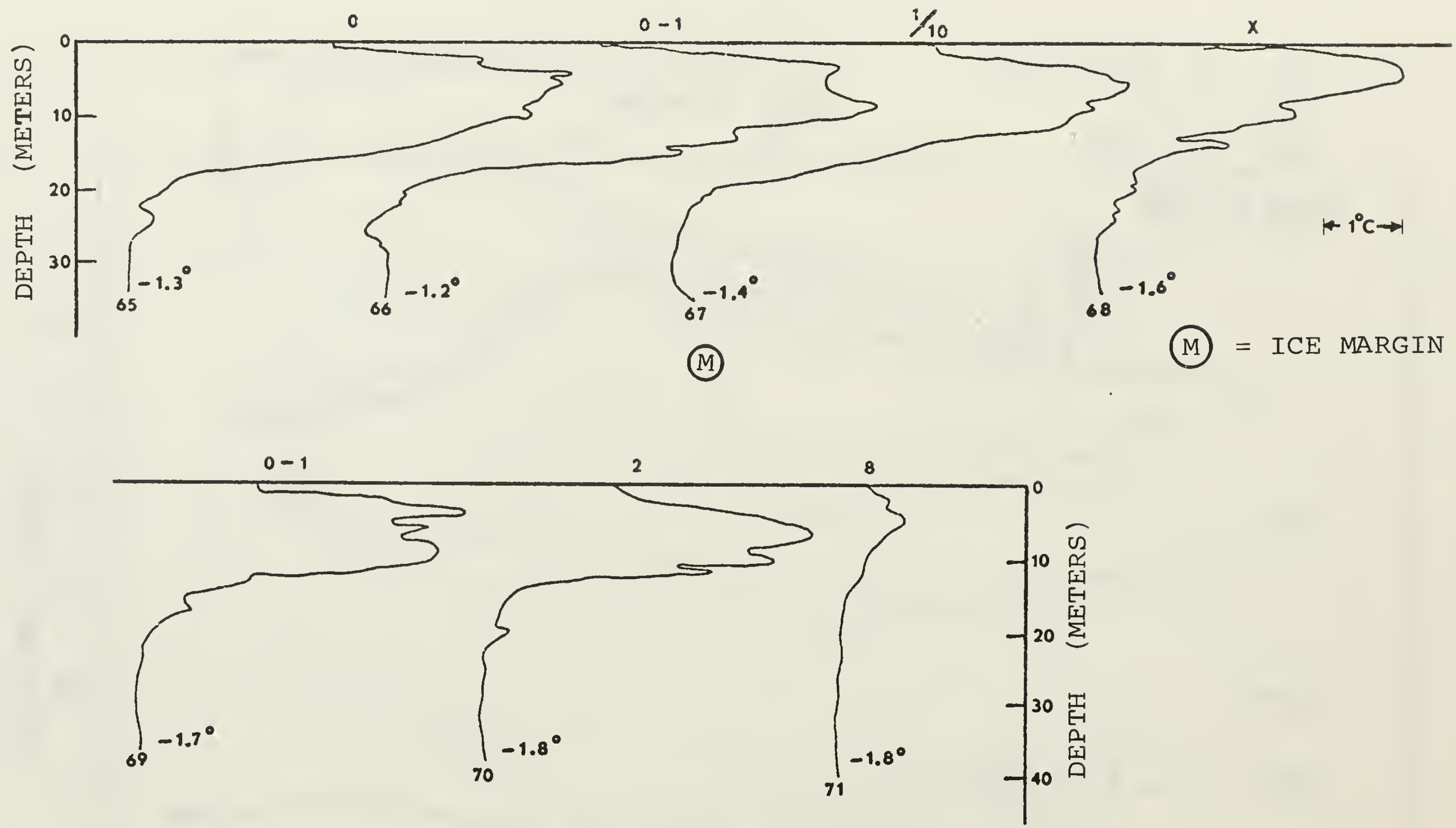
Temperature profiles for Crossing 4, continued.
Numbers at the top of trace are ice concentrations;
at the bottom of the trace the bottom temperature.



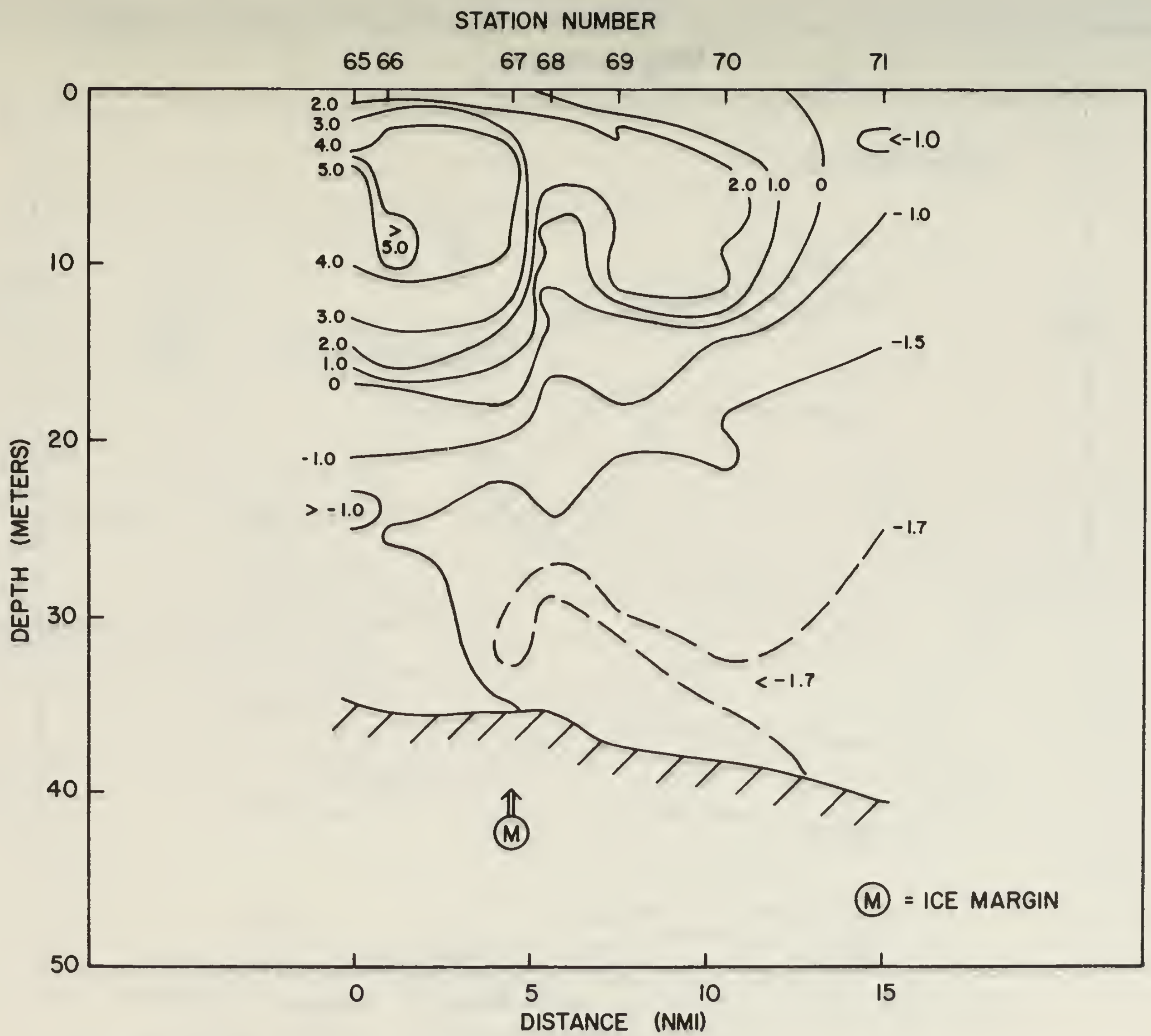
Temperature cross-section for Crossing 4.



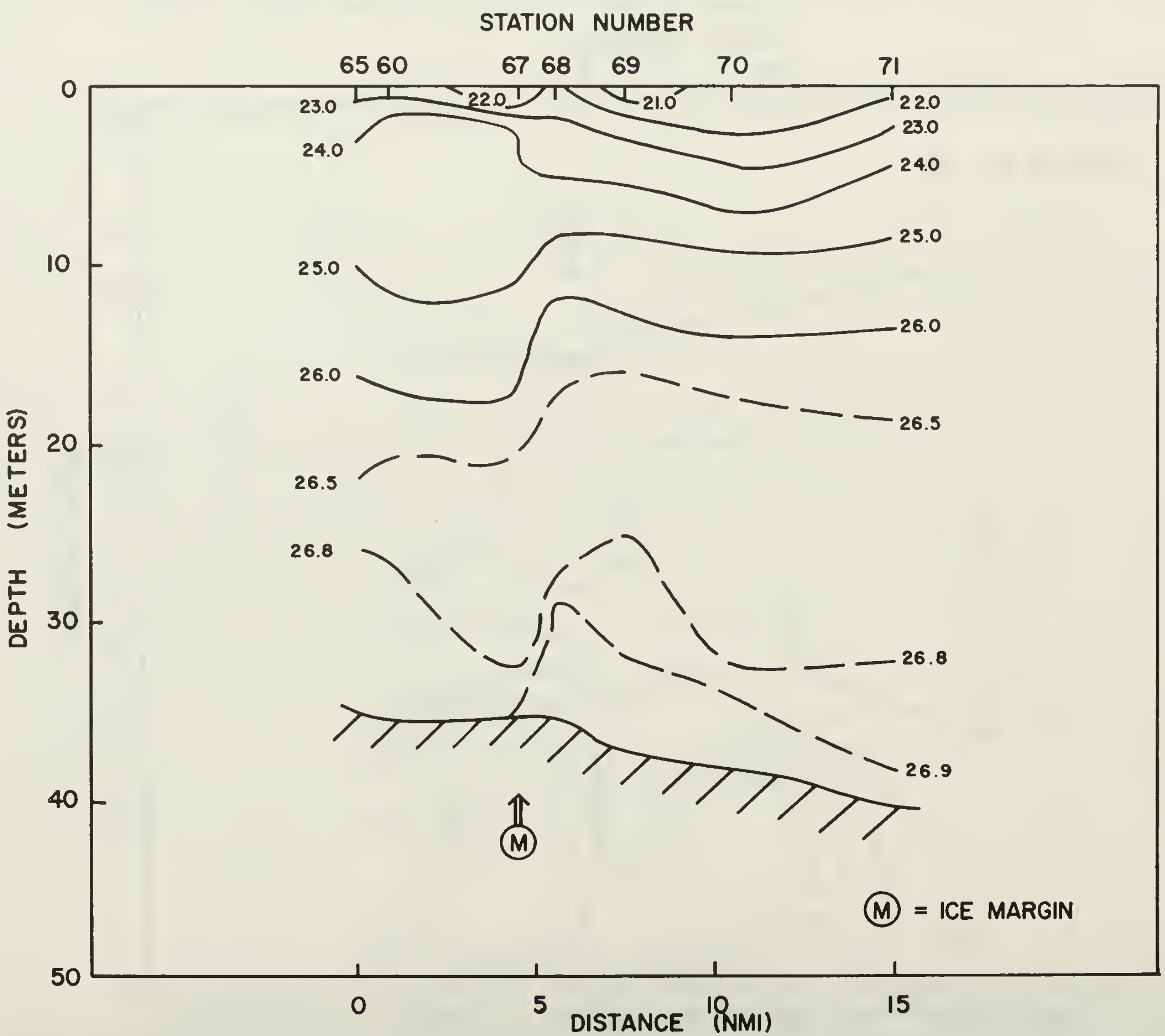
Sigma-t cross-section for Crossing 4.



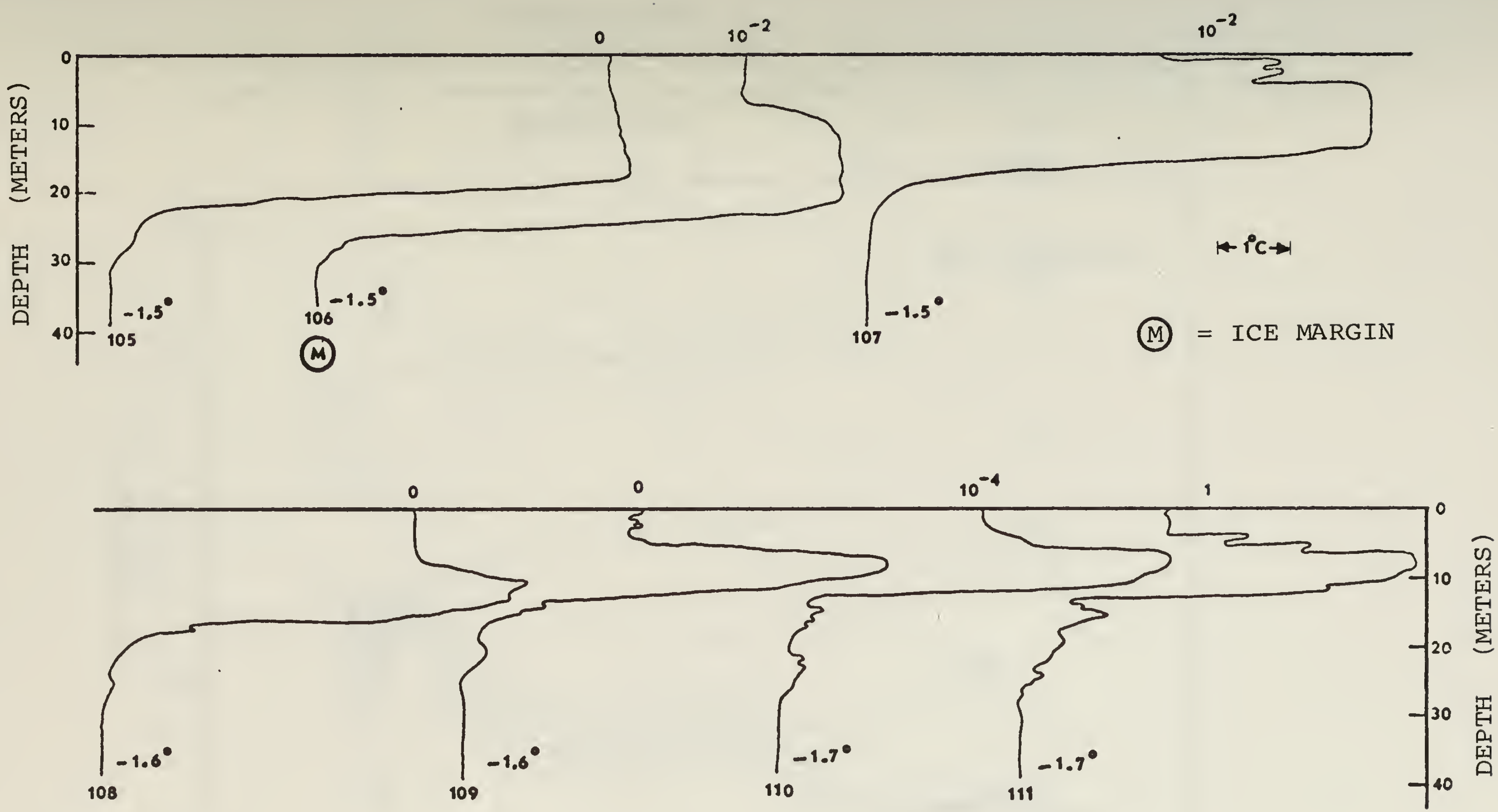
Temperature profiles for Crossing 5.
Numbers at the top of trace are ice concentrations; at the bottom of the trace the bottom temperature.



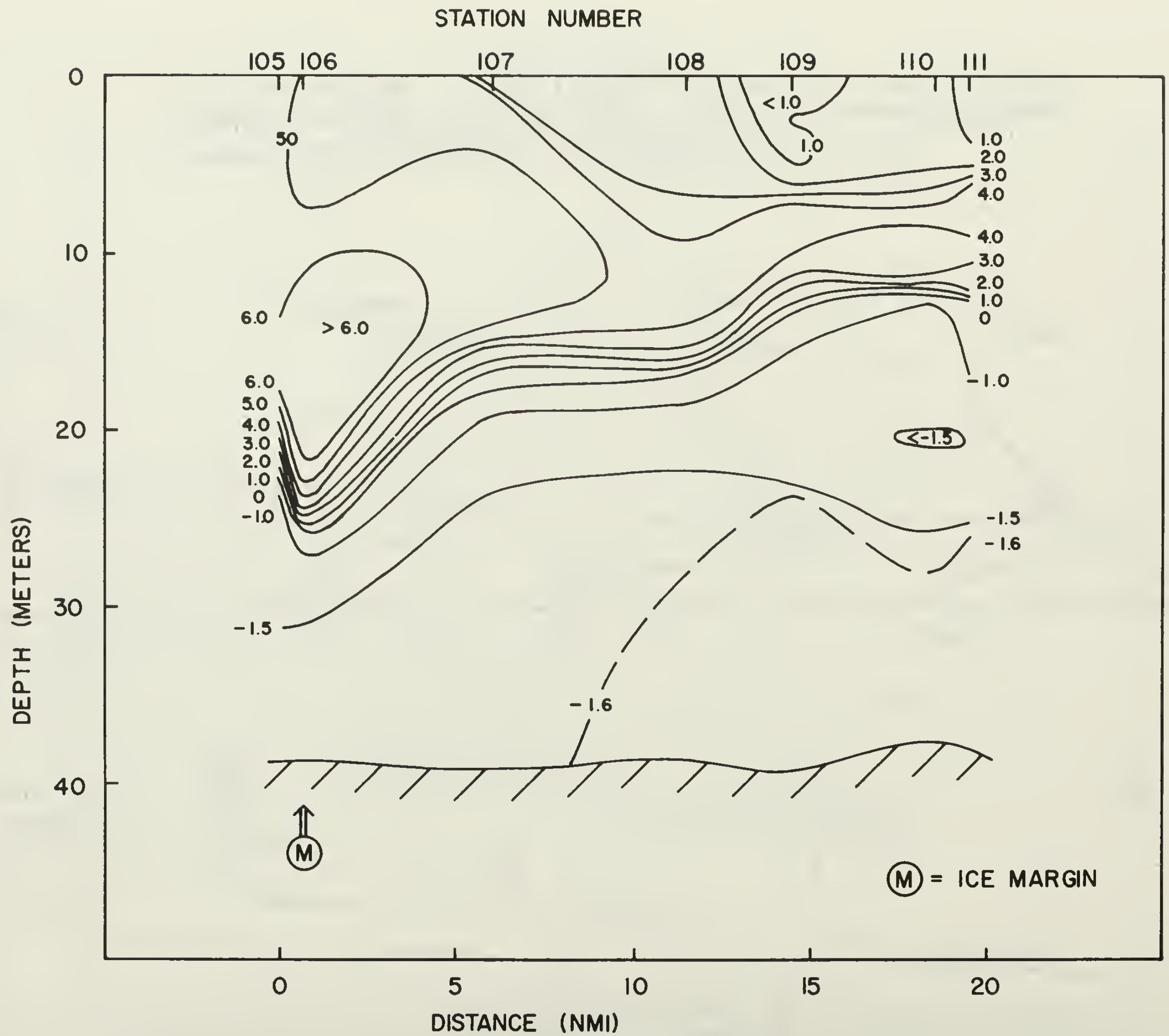
Temperature cross-section for Crossing 5.



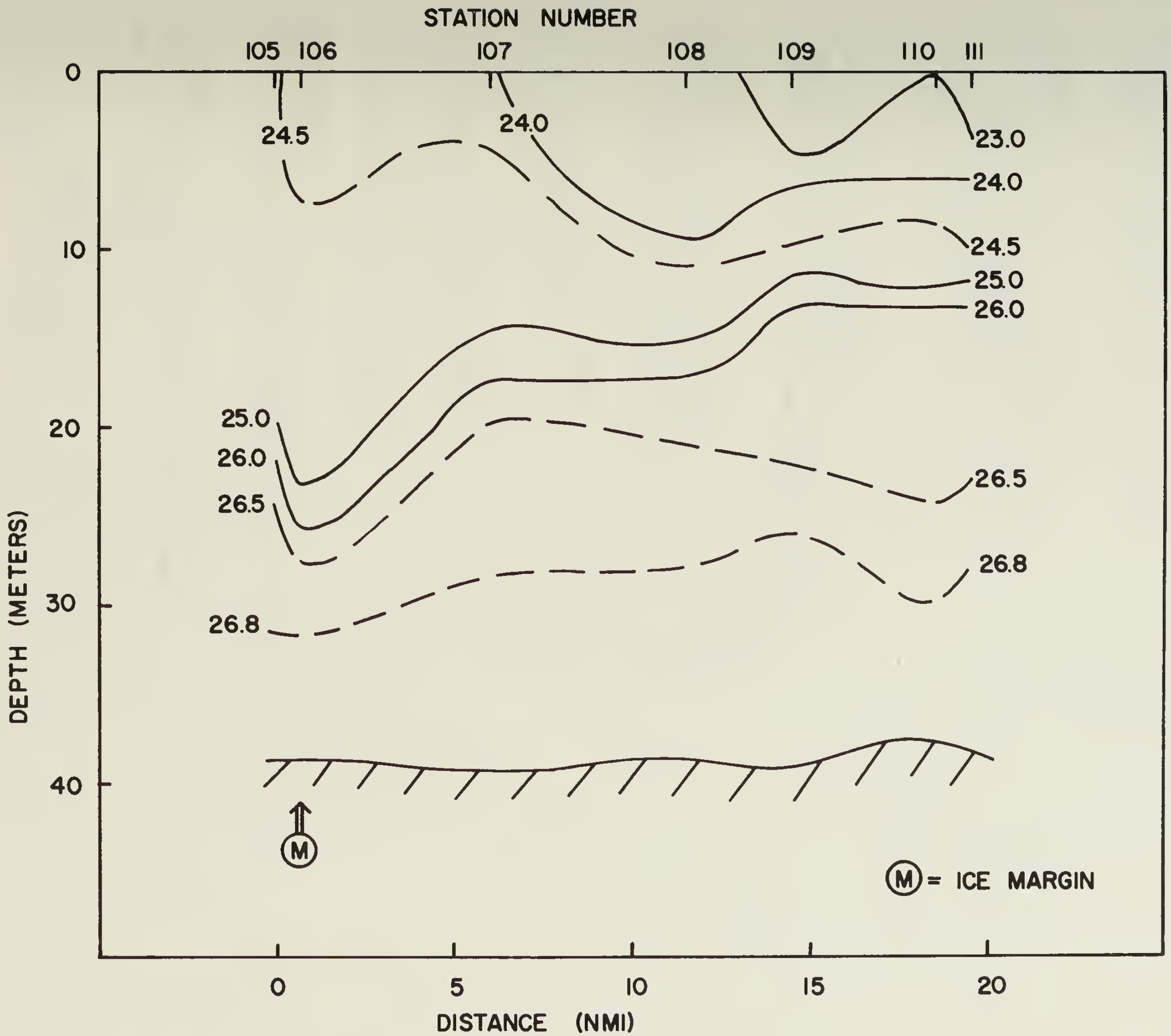
Sigma-t cross-section for Crossing 5.



Temperature profiles for Crossing 7.
Numbers at the top of trace are ice concentrations; at the bottom of the trace the bottom temperature.



Temperature cross-section for Crossing 7.



Sigma-t cross-section for Crossing 7.

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